Power Engineering

MARCH, 1957

E. M. Poston Generating Station..... 56

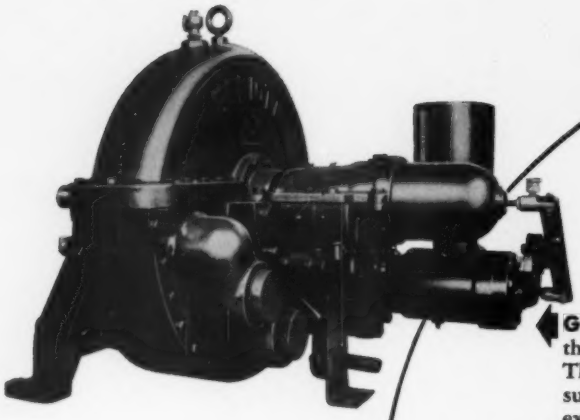
Get More With Synchronous Motors. 61

Turbine Heat Rates..... 64

Medical Center Steam..... 66

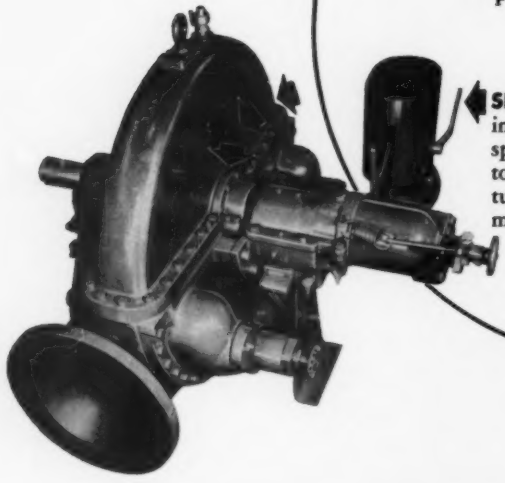
Preventive Maintenance..... 76

ANY WAY YOU LOOK AT IT..



HERE IT IS all insulated and lagged and ready for business. Makes a neat package of rugged "driveability", doesn't it? But let's take the dressing off...

GETTING DOWN TO THE BARE FACTS this shows the clean lines of the turbine. The steam inlet can be supplied in size suitable to the application, and the liberal exhaust connection provided on either side, as desired. Makes application simpler. Now take a bird's-eye view . . .



SEE HOW EASY IT IS to get at the packing rings with the separate horizontally split packing cases, without removing the top half of the turbine casing. This feature reduces the time required for normal maintenance.

Now look inside .

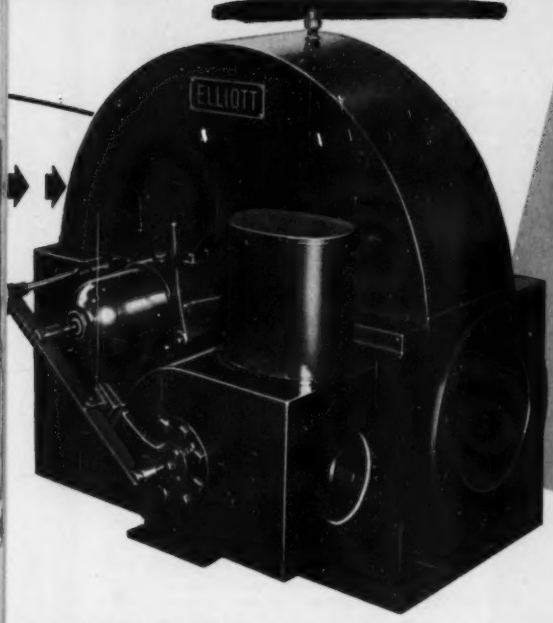
ELLIOTT Company

Steam Turbine Dept. • Jeannette, Pa.

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

it's some turbine!



ELLIOTT YR Turbine

...can be modified to almost tailor-made adapability to specific operating conditions

NOW YOU CAN SEE the airwall labyrinth bearing seal . . . The liner type horizontally-split main bearing . . . The dynamically balanced rotor, with stainless steel buckets and shroud . . . The ball thrust bearing which accurately locates the rotor . . . The simple, rugged mechanical shaft governor.

But all this is just part of the picture. True centerline support is a major factor, insuring unchanging alignment between turbine and driven unit, in spite of temperature change. Remember too the many modifications in controls and other features, all available without departure from standardization. Here's a mechanical drive turbine that is typical of the best in Elliott engineering. Why not 'phone your nearest Elliott office . . . . . or write us for Bulletin H-16?

H-737

A COMPLETELY NEW 44-PAGE EDITION

Now off the Press!

An Authoritative Guide to Good Trapping Practice

THE *new* Armstrong Steam Trap Book (Catalog J) is a practical working manual for any man concerned with the efficient operation of steam equipment through the correct selection, installation or maintenance of steam traps.

New Trap Catalog Section — complete data on Armstrong cast semi-steel and forged steel inverted bucket traps, compound traps and ball float traps, including: list prices, dimensions, capacities, service pressure ratings and materials.

New Handbook Section — tells how to select the right size trap for nearly every type and size of equipment; including steam mains, purifiers, separators, unit heaters, jacketed kettles, retorts, hot water heaters, coils and syphon drained cylinders; explains how to use the new Armstrong trap capacity chart; explains and gives recommended safety factors; includes reference tables and charts on such subjects as warming-up and radiation loads, condensing rates, recommended trap sizes, Armstrong trap EDR ratings, effect of scale on submerged coil condensing rates.

New Installation and Maintenance Section — covers trap hookups, use of check valves, preventive maintenance schedules, troubleshooting, many practical suggestions and answers to common problems.

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan

Please send me a free copy of the Armstrong Steam Trap Book.

Name.....

Job.....

Company.....

Street Address.....

City.....**Zone**.....**State**.....

EDITORIAL STAFF

ANDREW W. KRAMER
Editor

CHESTER R. EARLE
Managing Editor

RECORD H. ROGERS
Associate Editor

MARIAN E. HENIKEN
Equipment Editor

RICHARD H. MORRIS
Contributing Editor

THOMAS E. HANSON
Contributing Editor

JAMES E. WILCOX
Staff Artist

SBME Society of Business Magazine Editors

TECHNICAL PUBLISHING CO.
110 S. DEARBORN ST.
CHICAGO 3, ILLINOIS

KINGSLEY L. RICE, *President*
EDWIN C. PROUTY, *Exec. Vice Pres.*
WALTER PAINTER, *Vice President*
EDWIN C. PROUTY, JR., *Secretary*
ARTHUR L. RICE, JR., *Treasurer*
EARL R. NOREN, *Prod. Manager*
RICHARD WEIDNER, *Asst. Prod. Manager*

RICHARD M. WARD
Vice President in Charge of Sales

DISTRICT MANAGERS

CHICAGO: Arthur L. Rice, Jr.
John R. Morrison
110 S. Dearborn St., Chicago 3, Ill.
Phone: DEarborn 2-5446

NEW YORK: Richard Y. Fuller
Oscar Wilds
1613 Graybar Bldg., New York 17, N. Y.
Phone: Murray Hill 5-3779

PHILADELPHIA: Oscar Wilds
1235 Jericho Road, Abington, Pa.
Phone: Ogontz 7261W

CLEVELAND: Richard M. Ward
George L. Wright, Jr.
2945 Fairmount Blvd.
Cleveland Heights, Ohio
Phone: Fairmount 1-0616

PACIFIC COAST: McDonald-Thompson
Leslie Meek, Mgr.
625 Market St.
San Francisco 5, Calif.
Phone: Yukon 6-0647
Connie J. Grabb
3727 West Sixth Street
Los Angeles 5, Calif.
Phone: Dunkirk 7-5391
Harry Abney
Terminal Sales Bldg.
Seattle 1, Wash.
Phone: Main 3860

SOUTHWEST: McDonald-Thompson
Richard C. Wipperman
1118 Odeans Drive
Dallas 11, Texas
Phone: Winfield 4911

Subscription Information—Published Monthly. Prices: United States and Possessions one year $10.00, Canada one year $11.00. Other countries one year $12.00. Single copies $1.00. The Annual Index is furnished as a part of the December issue.

Contents of back issues of Power Plant Engineering and Power Generation and Power Engineering will be found in both the Industrial Arts Index and the Engineering Index on file in Public Libraries.

Copyright, 1952 by Technical Publishing Co.

ECA *Acceptance under Section 34.64 P. L. & R., authorized, Publication office, Concord, New Hampshire.*

Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

This magazine was established in 1896 as Practical Engineer. The title was changed to POWER PLANT ENGINEERING in 1918, to POWER GENERATION in 1948, and to POWER ENGINEERING in May, 1950. Rights reserved to above titles

March 1952

VOLUME 56—NUMBER 3

CONTENTS

E. M. Poston Generating Station of Columbus and Southern Ohio Electric Co. 56

This new semi-outdoor central station in Ohio has an initial capacity of two 40,000-kw units, is built right in the middle of its coal supply and gets all its water from shallow wells. You'll want to read how these factors influence its design and performance.

How to Get More Out of a Plant Power System with Synchronous Motors 61

By J. C. Moore

Everybody, of course, wants to get more out of his equipment to meet the demands of our rapidly expanding production. So, whether you must increase the load on your existing power system, or must build new systems, you ought to know how synchronous motors will help you, especially by boosting power factor.

Winter Meeting of AIEE Largest On Record 63

How to Figure Heat Rates of Big Modern Turbines 64

Based on data from turbines installed and tested since 1941, two teams of authors showed the ASME how to estimate and calculate the heat rates and other performance data for today's turbines. They predict turbine performance for future units up to 200,000 kw capacity and for steam conditions up to 2400 psig, 1100 F, with and without reheat.

Morton Salt's Semi-Outdoor Boiler 66

Just to show that the big power utilities are not the only ones who can benefit from semi-outdoor boilers, here's a most interesting spreader-stoker-fired semi-outdoor unit installed in a leading industrial power plant.

Steam for Chicago's Great and Growing Medical Center 68

International interest is focused on the great Medical Center now developing rapidly on Chicago's West Side. To supply steam to this great group of hospitals, clinics and research buildings, an unusual public utility has been set up. In this article, you get full technical details of its design and operation.

Practical Engineer and Electrician Section: Contents 71

Program, First Annual Meeting, American Power Conference .. 98

Regular Departments

Engineers' Preview 7 — Helpful Bulletins 37 — New Equipment News 42 — Catalog Library 48 — Construction News 50 — Letters to the Editors 55

The only magazine devoted exclusively to the engineering interests and practical problems of power engineers

OIC
FOUNDED 1883
THE
LONG
LINE
OF VALVES
Ford Motor Company's new foundry at Cleveland employed many OIC Valves; forged and cast steel for the power plant, iron and bronze valves for the heating and process piping.
THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO
OIC
FOUNDED 1883
VALVES
FORGED AND CAST STEEL · IRON · BRONZE

ENGINEERS' PREVIEW

DR. JOHN THEODORE RETTALIATA, 40, vice president and dean of engineering at Illinois Institute of Technology, Chicago, will be the new president of the Institute.

He assumed his new duties February 4. He succeeds Dr. Henry T. Heald, who planned to leave Chicago after the Institute's mid-year commencement February 2 to become chancellor of New York University. Dr. Rettaliata also was appointed president of Armour Research Foundation of Illinois Institute of Technology and the Institute of Gas Technology.

Dr. John T. Rettaliata

Dr. Rettaliata has been vice president in charge of academic affairs at the Institute since October 11, 1950. He has been dean of engineering since September 1, 1948. He joined the Illinois Tech staff in 1945 as director of the department of mechanical engineering.

A nationally-known expert on steam and gas turbines and jet propulsion, he has devoted a part of his time since last July as associate director of a high-priority classified Air Force research project at the University of Chicago.

Dr. Rettaliata is a vice president of the ASME. He has written scores of technical articles and papers on engineering subjects and has spoken throughout the nation on engineering and educational subjects.

A native of Baltimore, Maryland, he was born August 18, 1911. He received his Bachelor of Engineering degree in 1932 from the Johns Hopkins University and his Doctor of Engineering degree in 1936 from the same institution.

In 1936, he joined the Allis-Chalmers Mfg. Co., Milwaukee, Wis., as head of the calculation and development division of the steam turbine department. He was named manager in 1944 of the then new research and gas turbine development division of the steam turbine department.

During the summer of 1940, he was given a leave from Allis-Chalmers to study special applications of gas turbines on a fellowship awarded him by the National Academy of Science.

In 1941, Dr. Rettaliata received the junior award of the ASME for his paper on the Combustion Gas Turbine. A year later he received the highest award obtainable by a young mechanical engineer, the Pi Tau Sigma gold medal award, for outstanding achievement.

During World War II, he twice visited the European theater of operations at the invitation of the U. S. Navy. In 1943 he studied British developments in jet propulsion for the Bureau of Aeronautics. In 1945, shortly before and immediately after the surrender of the Germans, he investigated steam turbines developed by Germany for hydrogen peroxide submarine operations.

The steam turbine had never before been used for underwater navigation; and, as a direct result of Dr. Rettaliata's study, complete technical information on this type of turbine was made available to American manufacturers. For this work, the Bureau of Ships awarded him a special certificate of commendation.

In 1944 he was named to the subcommittee on turbines established by the committee on power plants for aircraft of the NACA.

In December, 1951, Dr. Rettaliata received a special award for "pioneering work in gas turbine development" from the ASME. (See January issue, page 83.)

He is past chairman of the gas turbine power division of the ASME and a member of the ASEE, ASNE, Sigma Xi, Tau Beta Pi, Tau Omega, and an honorary member of Pi Tau Sigma.

★ ★ ★

FRESH industrial frontier for the chemical industries through the production and utilization of acetylene is reviewed in the current issue of the *Technical Reports Newsletter*. Shortage of petroleum products in Germany during World War II spurred that country to expend tremendous effort into advancing the scientific knowledge of acetylene and promoting its industrial production. Since acetylene plays an important role in the synthesis of many chemical products its manufacture and use provides the new area of opportunity to which the reports provide a gateway. Single copies of the January, 1952 *Technical Reports Newsletter* are available without charge from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. or from the U. S. Department of Commerce field offices.

★ ★ ★

NEW HEAD of the Mechanical Engineering Department of Sam Tour & Co., Inc. is Henry N. Shoiket. Mr. Shoiket's eleven years of experience have been spent as a structural engineer with the Boeing Airplane Co., civilian mechanical engineer with the U. S. Navy, and draftsman with the New York City Board of Transportation.

★ ★ ★

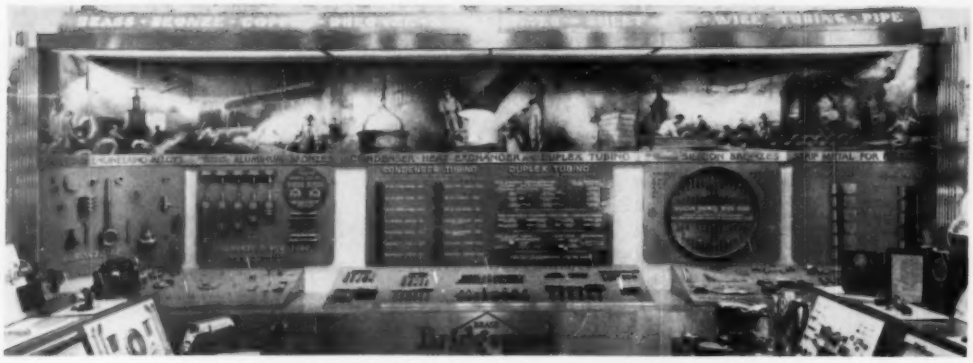
ENGINEERS working on power problems will be interested in the latest edition of the American Standard for Capacitor Units, C55.1–1951, just approved by the American Standards Association, 70 East 45th St., New York 17, N. Y. You can get a copy from ASA for 40 cents.

The standard being superseded was issued in 1934 and is now very much out-of-date. It covered capacitors for all applications. The new standard covers shunt and series capacitor units for use on a-c power transmission and distribution systems, at nominal frequencies of 60 cycles and below, used for the purpose of modifying the performance of the system at normal frequencies. By definition, the standard excludes high frequency capacitors for use in communication service and also excludes capacitors used in connection with instrumentation. The standard applies to capacitors used in power systems and industrial plants for correction of power factor, and for voltage regulation when connected in shunt across the line.

★ ★ ★

JAMES P. GROWDON, chief hydraulic engineer for Aluminum Company of America since 1938, will become an engineering consultant on hydraulic and related engineering problems for ALCOA, effective February 1. B. J. Fletcher, assistant chief hydraulic engineer, will succeed Mr. Growdon as chief hydraulic engineer.

★ ★ ★



Portion of Bridgeport Brass Co.'s recently-opened progress exposition

PROGRESS exposition, designed to better acquaint employees and their families with the company's facilities, fabricated products and the end use of its mill materials, was opened by Bridgeport Brass Co., Bridgeport, Connecticut, January 14, in the Company Clubhouse.

Murals and both company and customer exhibits carry out two main themes of the exposition: 1. the innumerable products in which copper, brass and bronze from the company mills are used and 2. the industrial growth of the firm from a mill standpoint as well as in the manufacture of Aer-A-Sol products, tire valves and plumbing goods.

After the visitation by employees, customers will be invited to attend, followed by visits from interested public school and university students in the Bridgeport area.

At one end of the clubhouse, a mural showing mill and fabricating division operations covers the entire wall. Around both the first and second floors of the buildings other murals show engineering developments advanced by Bridgeport through its long history. These include the micrometer, the use of the electric furnace for melting copper and brass, the first overhead railway wire and many others. The murals, painted for the exposition by Ralph L. Boyer, will be a permanent part of the clubhouse.

★ ★ ★

CHOSEN outstanding engineer of Oregon in 1951 for his work in hydro-electric power development, John C. Boyle of Medford was awarded the Professional Engineers of Oregon Certificate of Merit at the annual Professional Engineers of Oregon banquet January 26 by H. S. Johnson, outgoing president of the group.

Vice president, as well as general manager and acting chief engineer, of the California-Oregon Power Company, Boyle is a graduate of the University of California. He has been with California-Oregon and its predecessor, Siskiyou Electric Power and Light Co., since 1910. Honored for his outstanding work in the field of hydro-electric engineering, Boyle has been instrumental in quadrupling the output of Southern Oregon hydroelectric power potential since 1944.

★ ★ ★

STEAM power capacity at the Midland, Penna., Works of Crucible Steel Co. of America will be modernized and increased with the installation of two new boilers, according to The Rust Engineering Co., the constructor. The project is expected to cost about $1,225,000.

Six blast-furnace-gas-fired Rust boilers, in use since 1905, are being removed to provide space for the new Babcock and Wilcox steam generators which will have a rated capacity of 75,000 lb per hr at 250 psi. They will be equipped to burn blast furnace gas, with provisions for firing with pulverized coal or coke oven gas. Construction is expected to be completed sometime this spring.

★ ★ ★

IN APRIL, 1951, the Schiller Station Mercury Unit Power Plant of the Public Service Co. of New Hampshire, which was designed and built by General Electric on the customer's mat, was tested to accurately determine the station's net heat rate. This modern power plant was completely tested with calibrated instruments and with all operating conditions held constant to close tolerances.

Results were 9133.7 Btu per net kwh at a net station output of 41,419.3 kw, compared to the figure of 10,000 to 12,000 Btu per kwh for many plants of the same size. This high economy is believed to have established a world record for this size of plant and GE engineers say it demonstrates the inherently high thermal efficiency of the mercury-steam binary cycle.

Test arrangements and procedures were carried out by various General Electric groups, engineers of the utility, representatives of Stone & Webster Engineering Corp., and The Babcock & Wilcox Co. as well as two instructors, Robert Jodrey and Gardner Ladd, and the entire senior mechanical and electrical engineering classes of the University of New Hampshire.

★ ★ ★

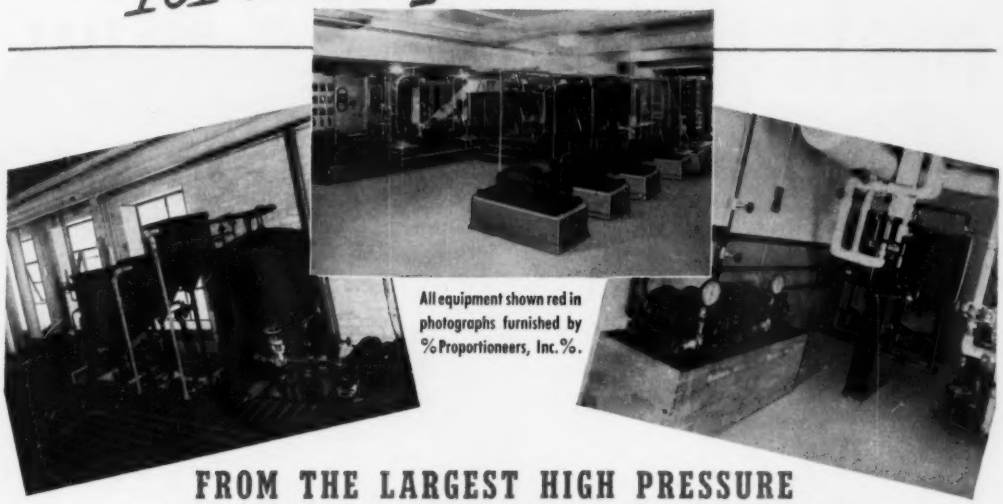
LATEST major step to help meet defense needs for aluminum in the U. S., and other nations of the free world, is a 150-percent expansion of Aluminium Limited bauxite-alumina production facilities in Jamaica, involving an additional Canadian investment of at least $20,000,000 in the Caribbean area. It is now under actual construction. Under the new program, the Company's Jamaica alumina plant, first in the Caribbean, will have its planned capacity increased from 200 short tons to 500 tons of alumina per day. The increase is required to provide more raw material for Canada's rapidly expanding aluminum industry. Further enlargement to 740 tons per day is called for in the Company's plans as a successive development.

Manufacture of alumina in Jamaica, rather than shipping out the raw bauxite ore, reduces shipping costs by more than half.

★ ★ ★

CHEMICAL TREATMENT METERING PUMPS

for Every Power Plant



All equipment shown red in photographs furnished by %Proportioneers, Inc.%.

FROM THE LARGEST HIGH PRESSURE INSTALLATION TO THE SMALLEST LOW PRESSURE JOB

PLUNGER TYPE PUMPS
FOR HIGH PRESSURES
Simplex • Duplex
Triplex • Quadruplex

•

DIAPHRAGM TYPE PUMPS
FOR UNIVERSAL APPLICATION AT LOW PRESSURE
Simplex • Duplex
Triplex • Quadruplex
Complete interchangeability of parts in each group

We furnish complete Chemical Feeding Systems

%Proportioneers, Inc.% can supply control panels together with chemical tanks, dissolvers and all other units required — a single responsibility for your complete chemical feeding system.

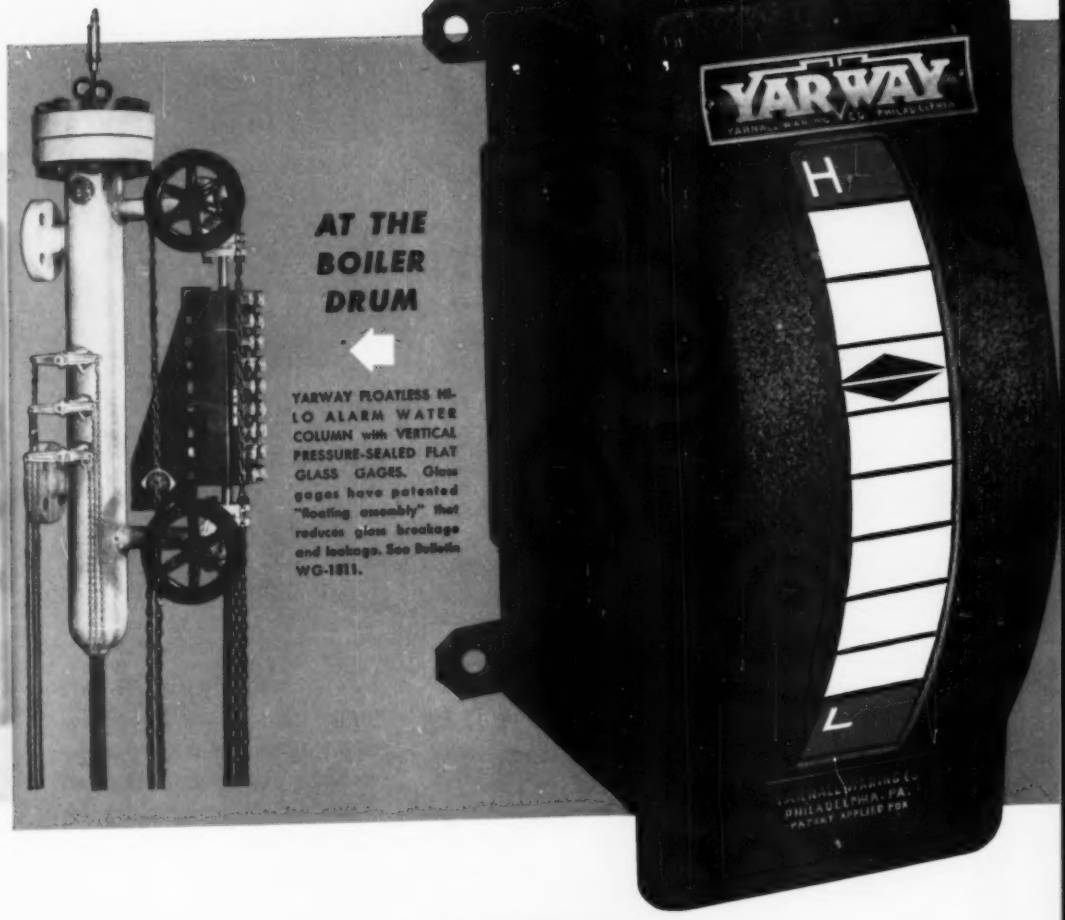
Write for Brochure SM 122 and Bulletin CAT.

% PROPORTIONEERS, INC. %

Write %PROPORTIONEERS, INC.%, 385 Codding Street, Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

Boiler Water Indication


AT THE BOILER DRUM
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN with VERTICAL PRESSURE-SEALED FLAT GLASS GAGES. Glass gages have patented "floating assembly" that reduces glass breakage and leakage. See Bulletin WG-1811.
YARWAY
H
L
PHILADELPHIA, PA.
PATENT APPLIED FOR

YARWAY

ON THE LEVEL with a Yarway System

It's accurate! It's where you can see it!

These two most important needs for boiler water level indication are assured with a Yarway system.

Yarway indicating equipment is accurate because it is *operated directly by the boiler water itself.* Yarway Weight-operated Hi-Lo Alarm Water Columns with either Secure Inclined or Flat Glass Vertical Gages take care of the job at the boiler drum. On the instrument panel or other desired location, Yarway Remote Liquid Level Indicators bring overhead gage readings down to convenient, easy eye-level vision. By use of a Control Unit on the indicator, additional Hi-Lo light or sound alarms can be located at any place in the plant.

The Yarway HI-LO-GRAPH, a panel-mounted *recording* indicator, gives a 24-hour record of boiler water levels.

Yarway engineers will gladly show you how the Yarway Boiler Water Indicating System increases power plant *safety* and *efficiency.*

For the full story on Yarway Indicators, write for a free copy of Yarway Bulletin WG-1822.

YARNALL-WARING COMPANY, 114 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

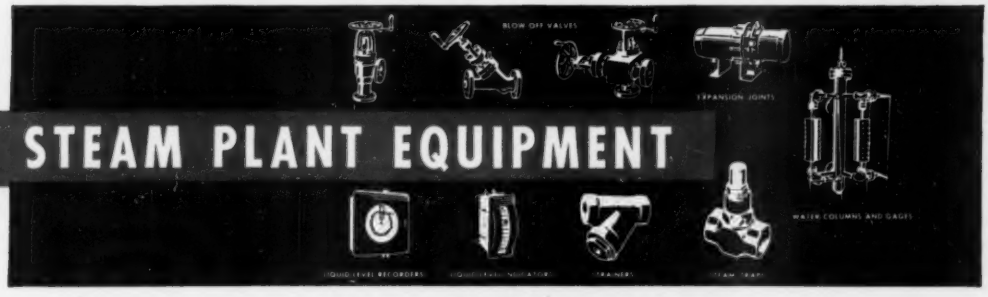
ON THE INSTRUMENT PANEL

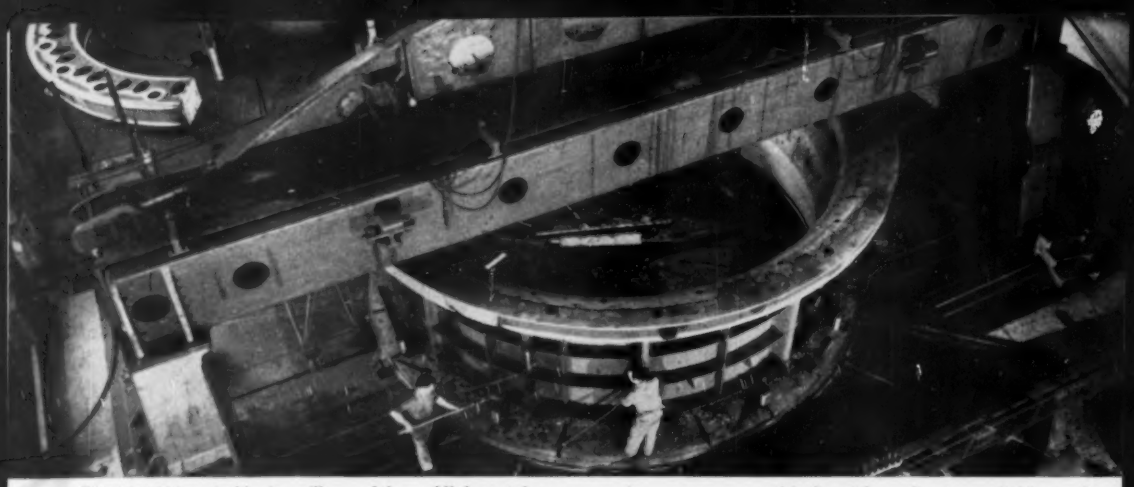
YARWAY REMOTE LIQUID LEVEL INDICATOR, operated directly by the boiler water itself, by the pressure differential between a constant head and the varying head in the boiler drum. Indicating mechanism is never under pressure—no stuffing boxes. See Bulletin WG-1822.

YARWAY HI-LO-GRAPH RECORDER provides not only instant indication but also 24-hour recording of boiler water levels. See Bulletin WG-1830.

ANYWHERE IN THE PLANT

YARWAY REMOTE HI-LO ALARM SIGNALS, lights or horns. Operated by Control Unit attached to Remote Liquid Level Indicator or Recorder. Any number can be installed, at any desired locations throughout the plant. See Bulletin WG-1822.





This $400,000 vertical boring mill, one of the world's largest, bores, turns and faces hydraulic turbine parts. Sunoco Way Lubricant, approved by 38 machine tool builders, was selected by the design engineers to prevent stick-slip with resultant poor finishes and scoring of ways and slides. On this machine, even with work as heavy as 75 tons, Sunoco Way Lubricant has never squeezed out.

THESE "JOB PROVED" SUN PRODUCTS HELP BOOST PRODUCTION AND REDUCE OPERATING COSTS

When a Sun representative recommends a lubricant or cutting oil, he does so with confidence. Every product developed in Sun's laboratories is exhaustively tested by actual use in industry until desired performance characteristics have been clearly established. Only then is it rated "Job Proved" and offered for sale.

In tackling your problems, a Sun representative draws on the wealth of experience he has acquired working in all fields of industry. If the technical nature of your problem calls for it, one of a special group of Sun mechanical and chemical engineers will go to work in your behalf. Back of them, remember, are the vast research, development and refining facilities of Sun Oil Company. All this is your assurance that Sun products will help you boost production and reduce operating costs.

Full information about Sun oils and greases or the services of a Sun representative are yours for the asking. Just call or write the nearest Sun Office.

GENERAL LUBRICANTS

SUNVIS 900 OILS. Unexcelled for turbine lubrication, as a hydraulic medium, for circulating systems, and for similar applications requiring longest possible oil life, plus maximum protection to equipment. Sunvis 900 Oils have a high viscosity index and uniform 0°F pour point, and are fortified against corrosion and oxidation.

SUNVIS OILS. Give long, trouble-free service in all types of industrial reservoirs and circulating systems operating at normal temperatures. Sunvis Oils have uniform high viscosity index, low pour point, and low carbon content.

SUNVIS H.D. 700 OILS. For internal combustion engines operating under heavy-duty conditions, or where hydraulic valve-lifters are used; for circulating systems and other industrial applications where contamination is a factor. Sunvis H.D. 700 Oils supply detergency, and minimize oxidation and corrosion.

DYNAVIS OILS. For internal combustion engines operating at moderate loads and speeds. These low-pour-point, high-viscosity-index, inhibited oils help prevent formation of harmful corrosive and sludge-forming acids.

CIRCO OILS. Straight mineral oils for general lubrication of industrial machinery. Unsurpassed for once-through applications, regardless of operating temperatures.

SOLNUS OILS. Approved by many manufacturers for air compressors, vacuum

Now 95 bottles a minute can be processed continuously by this washer, thanks to a Sun Adhesive Pressure Grease. In the past, shutdowns were required after short intervals because the lubricant then in use did not adhere, leading to open gear failures.

pumps, low-speed diesels, and general lubrication where a high-quality straight mineral oil is needed.

SUNEP OIL. Lead-naphthenate type of lubricant for heavy-duty gears and other applications. Great stability, plus rust preventive and non-corrosive characteristics, helps prolong life of gear sets.

SUNTAC OILS. Recommended for general lubrication of all machines where dripping and splash should be held to a minimum. Compounded to increase adhesiveness, Suntac Oils cling to bearing surfaces and supply constant, superior lubrication.

STEAM CYLINDER OILS. Lubricants of high flash and fire point for saturated or superheated steam conditions and for worm gear speed-reduction units.

SUNOCO WAY LUBRICANT. Eliminates "stick-slip" of tables and scoring of machine tool ways. Noncorrosive, with outstanding metalwetting and adhesive properties, ample viscosity and E.P. qualities. Approved by 38 leading machine tool manufacturers.

ROCK DRILL OIL. High-film-strength oil for use in jackhammers, stopers, drifters and similar equipment.

INDUSTRIAL GREASES

SUN GUN GREASES. Smooth greases with excellent pumpability characteristics. Designed for pressure fittings on equipment operating at normal speeds and temperatures.

SUN ADHESIVE PRESSURE GREASES. Won't drip or splash. Excellent lubricants for open-gear applications.

SUN DARK PRESSURE-SYSTEM GREASES. For power-driven central grease lubricating systems in heavy industries. Also used as "medium cup greases."

SUN MINE CAR GREASES. Available in several grades. Suitable for both antifriction bearings and plain-bearing cavity type wheels.

SUN MINING MACHINE LUBRICANT. Semifluid. For use where a light but adhesive grease is required. Resists separation and decomposition.

SUN ROLLER BEARING GREASES. For use on electric motors and generators and high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS. Black adhesive open-gear compounds and wire-cable greases. Recommended for power presses, mining machinery, worn reduction mills, crushers, pump gears, etc.

SUNOCO TRACTOR ROLLER COMPOUND. For crawler type tractors. Provides good lubrication with exceptional sealing qualities.

METALWORKING OILS

SUNICUT. Straight (non-emulsifiable) transparent cutting oils. Various grades for automatic screw machines and heavy-duty machining operations. Permit high-speed production with excellent finishes, long tool life.

SUNOCO EMULSIFYING CUTTING OIL. An emulsifiable oil which produces a stable white emulsion when mixed with water. Efficient and economical cooling and lubricating medium for turning, milling, drilling and other metalworking operations on both ferrous and nonferrous metals. It is also an excellent grinding coolant. Available in heavy-duty grades also.

SUN QUENCHING OILS. Specially refined oils designed to aid development of maximum desired physical properties in a wide variety of steels.

SUN TEMPERING OILS. Specially refined oils for tempering steel. Because of their low carbon content and stability under heat, these oils have an unusually long service life.

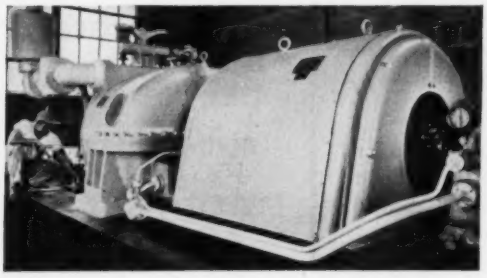
SUN ROLLING OILS. Straight and emulsifying oils which permit maximum production in rolling steel, aluminum, brass and copper.

REFRIGERATION OILS

SUNISO REFRIGERATION OILS. High-quality oils with extremely low pour points, extremely low wax-separating characteristics, great stability, and long life. Initially neutral and resistant to formation of detrimental acids. Suniso grades are available to meet all low, normal and high temperature conditions. The most widely used oils in refrigerating and air-conditioning.

ADDITIONAL INDUSTRIAL PRODUCTS

SUN SOLVENTS. Sun Spirits for the thinning of paints, varnishes and enamels, for metal-cleaning, and for certain types of processing and extraction . . . a pure, water-white petroleum solvent, free of corrosive sulfur. Other Sun solvents with special properties are available for the chemical industry.



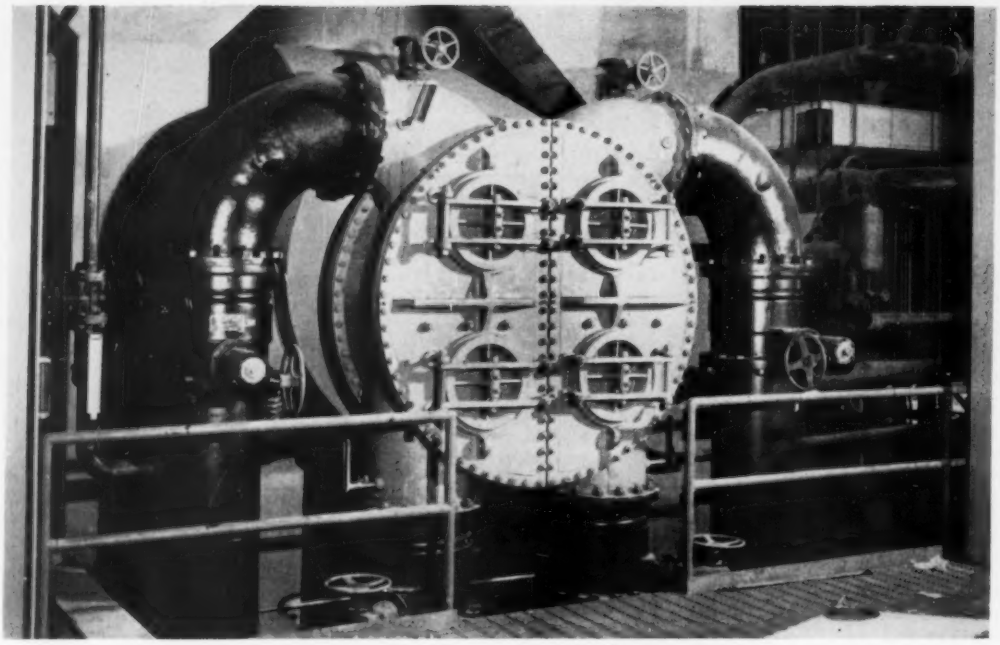
This turbine supplies most of Nantucket Island's power during summer peak loads. In winter it is idle, but journals, bearings and controls always remain free of sludge, rust and corrosion—because Sunvis 916 protects them. Its metalwetting characteristics prevent any moisture present from displacing the oil.

Gates, valves and capstans—the entire mechanism of this new Monongahela River lock—operate hydraulically. The engineers in charge chose Sun Hydraulic Oil over all others because they felt it could be best counted on to keep the lock in operation and river traffic moving despite extremely rigorous conditions.

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO



CONSECO 2-PASS CONDENSER

helps turn out low-cost power at Henderson, Kentucky Plant

Pictured above is the Conseco 6000 sq. ft. 2-pass, divided-flow condenser installed in the Municipal Power Plant of Henderson, Kentucky.

This Conseco unit handles a 5000 kw. turbine. Also installed in this modern municipal plant is a Conseco twin-element, two-stage air ejector & a single element, non-condensing hogging ejector.

WRITE for latest engineering bulletins on Conseco Condensers, Ejectors and other power plant equipment. They point the way to smoother plant operation and lower power cost.

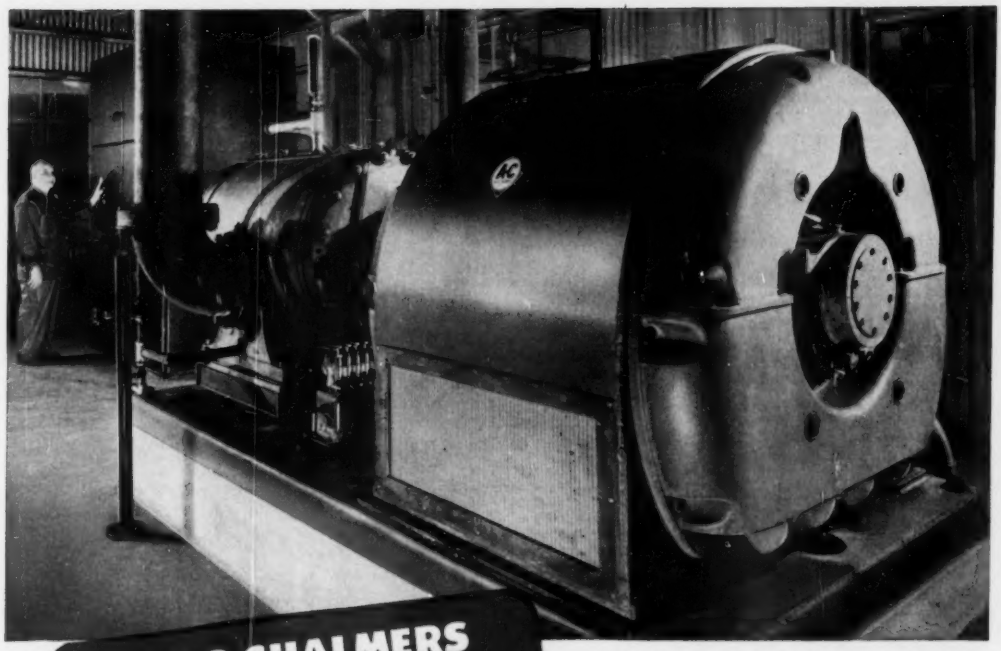
CONSECO

PRODUCTS *include:*

BOILERS
•
EVAPORATORS
•
CONDENSERS
•
REFINER FILTERS
•
STEAM JET AIR EJECTORS

CONSECO

CONDENSER SERVICE & ENGINEERING CO.
HOBOKEN, NEW JERSEY



All Allis-Chalmers installation: 250-hp, 495-rpm, drip-proof cage motor; single-stage rotary compressor; controller.

ALLIS-CHALMERS Large Motors ... Provide Low-Maintenance Reliability

START with construction features that have already earned a reputation for ruggedness and reliability. Add all-around drip-proof and mechanical protection. And do this without sacrificing accessibility for routine maintenance.

That's how Allis-Chalmers large cage motors were redesigned. That's why you'll want these advantages in your new motors:

IMPORTANT FEATURES

● Rigid cast-iron end shields assure you of correct bearing alignment and corrosion resistance as well as drip-proof protection.

● Capsule-type bearing housings enable you to leave the bearings and oil supply sealed against abrasive dirt when you remove the top halves of the end shields to clean the windings.

● Large air discharge openings in the yoke invite you to keep the ample passages back of the stator core clean and unobstructed. They also make installation easier.

● Louvers on air discharges and design of intakes keep foreign objects out of the motor.

A-3561

NEW BULLETIN

Built in ratings from 60 hp at 300 rpm to 1750 hp at 1800 rpm, these cage motors are described in detail in bulletin 0587542A. Ask your nearby Allis-Chalmers representative for a copy, and see for yourself why these redesigned motors provide a new low in maintenance and a new high in reliability. Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

Revolutionary Performance!

Riley Boiler Unit gives bonus of 20,000 pounds per hour of steam to Masonite Corporation

Here's the maximum capacity guaranteed to Masonite by Riley Stoker Corporation:

50,000 lb. continuous
60,000 lb. for 15 min. peaks

And here's the Masonite report on performance: "For the past 75 days the average hourly load on the new boiler has been 70,000 pounds with peaks of one and more hours' duration of 75,000 pounds."

This same installation called for a guaranteed air heater gas temperature not in excess of 395 degrees at 50,000 pounds of steam per hour. In actual operation at 54,500 pounds of steam per hour, the air heater exit gas temperature was only 377.5 degrees!

No wonder Riley Stoker Corporation, Worcester, Massachusetts, is so well known among leading plants throughout the nation for the highly efficient performance of its boilers!

Coppus-Dennis FANMIX Burners Were Installed

To assure such revolutionary performance, Riley specified Coppus-Dennis FANMIX Burners for its boilers. The exclusive FANMIX action — on *all* Coppus burners, gas as well as combination gas-oil — is the reason for such performances.

FANMIX : Better Combustion : Better Efficiency : Higher Ratings

FANMIX burners, with their *revolving orifices*, give violent mechanical mixing and agitation of gas and air and, therefore, instantaneous and complete combustion with *minimum excess air* (5% excess air not unusual).

Furnace space is not required for mixing; therefore, *higher boiler ratings* are easily obtained.

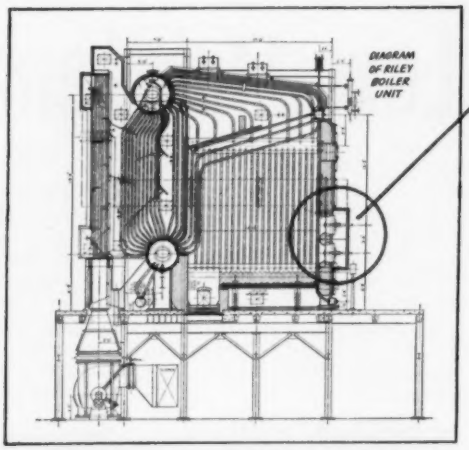
FANMIX burners, with shorter flame than any other burner, cannot cause flame impingement.

FANMIX burners, incorporating a *fan* as an integral unit, have *no draft loss* across the burner. Therefore, regardless of draft conditions, increased ratings are possible.

FANMIX action, with its quick completion of combustion, gives *lower* exit gas temperatures.

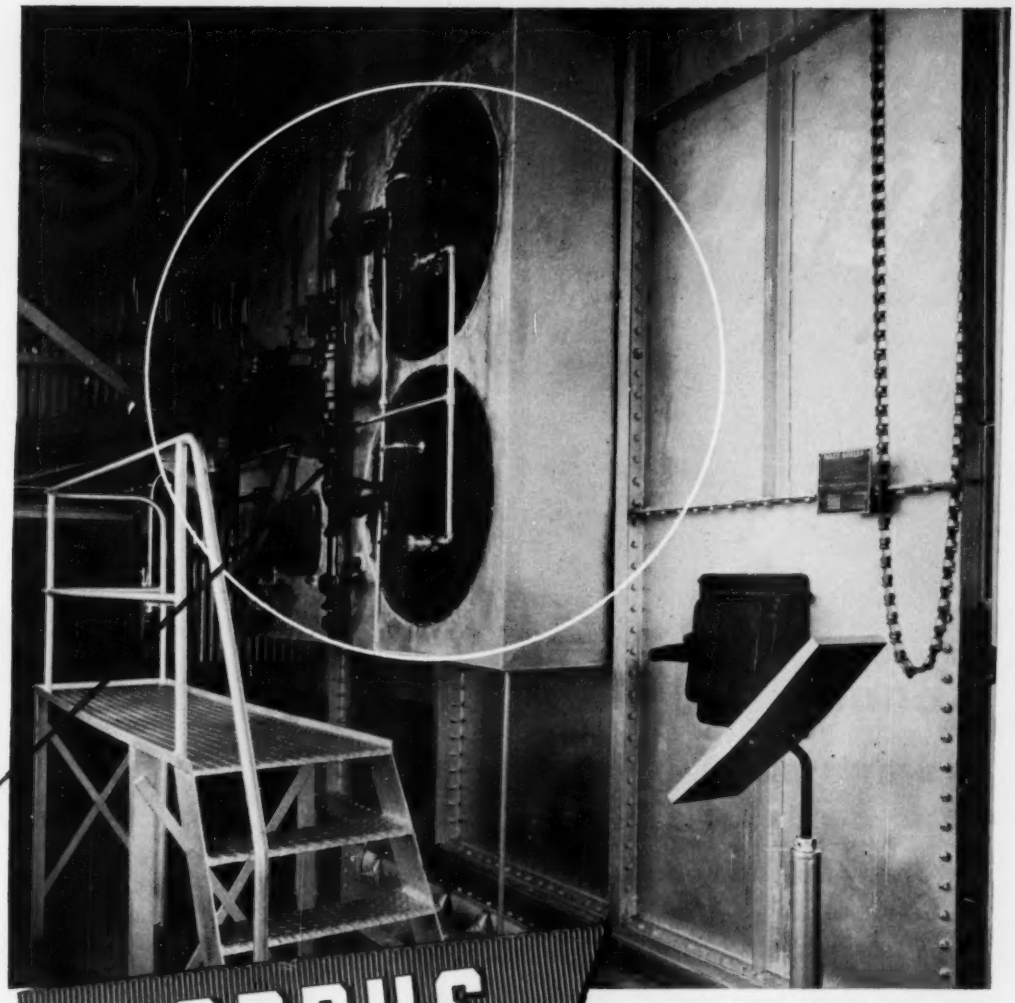
Plan now to take advantage of Coppus-Dennis FANMIX action with your present boiler. Remember — no forced draft equipment nor increase in stack nor increase in furnace volume is required for *FANMIX* operation to get increased capacity. And on *new* boilers, FANMIX lets you plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity, and *no* forced draft equipment. Mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory, and Mining Catalogs*.

JET REACTION is utilized to rotate fan which is integral part of burner. Automatically proportioned high velocity air passes at right angles through fuel to create ideal mixture for fast, complete combustion and peak efficiency.



Well-Known Users of Riley Units with FANMIX Burners Include:

Publicker Commercial Alcohol Co.
Monsanto Chemical Co.
Gaylord Container Corp.
Commercial Solvents Corp.
Celanese Corp. of America
Gulf Power Co.
Mississippi Power Co.
Eagle-Picher Lead Co.
Humble Oil & Refining Co.
Godchaux Sugars, Inc.
Kennecott Copper Corp.
Nicholson File Co.
Bird & Son, Inc.
— and many others



RILEY BOILER UNIT, using FANMIX burners, is here shown as installed for the Masonite Corporation, Laurel, Mississippi. Circle in diagram at left indicates position of burners pictured above.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
163 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in
☐ gas ☐ combination gas-oil.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

They're DROP FORGED

of STEEL...

W-S Screw-End and Socket-Weld Fittings

There are several big benefits to you implied in this simple statement of fact about W-S Fittings.

First, forging means *strength*—the strongest, most compact physical form, steel for steel, obtainable by commercial methods of fabrication.

Second, *being* stronger, forged fittings are much *smaller* and *lighter*, size for size, than other types.

Third, *dimensional accuracy* is characteristic of the forging process—and because forged bodies *are* more accurate, they chuck better, can be machined to *closer*, more *uniform tolerances* than other types.

To these inherent advantages of *forged* fittings, add Watson-Stillman's modern manufacturing facilities, a production control system that's air-tight from furnace to finished product, and a sales engineering staff dedicated to SERVICE in the largest sense of the word. The total is heavily weighted in favor of the advantages of W-S Double-Diamond Forged Steel Fittings.

• Lower Service Cost • More Uniform
• Stronger • Smaller • Lighter • Tighter

SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

WATSON-STILLMAN
ESTABLISHED 1848

W S

9-M-1

DISTRIBUTOR PRODUCTS DIVISION

ROSELLE, NEW JERSEY

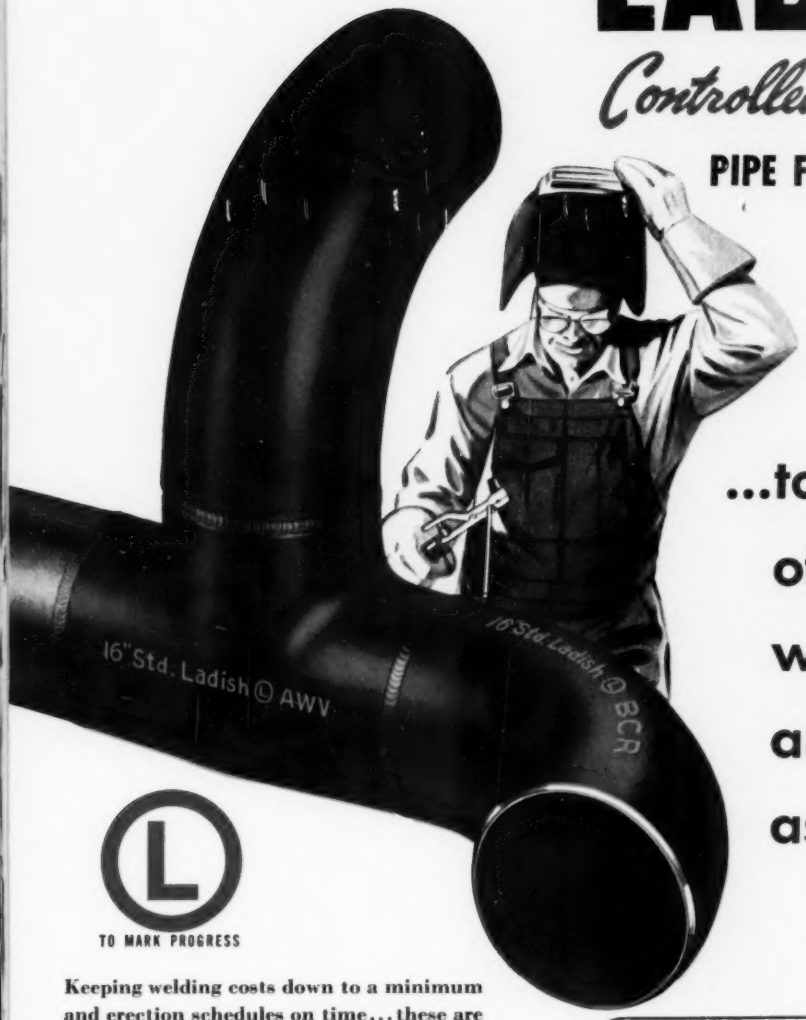
Designers and Manufacturers of Forged Steel Fittings, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS



...to be sure of sound welds and fast assembly

TO MARK PROGRESS

Keeping welding costs down to a minimum and erection schedules on time... these are important advantages you can assure to any piping job by installing Ladish Controlled Quality fittings. Metallurgical controls over materials and methods provide an assurance of uniform weldability in every Ladish fitting... and thorough inspection to rigid standards of physical dimensions and geometric accuracy assures fast piping assembly.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M

In the widely diversified line of Raybestos-Manhattan packings and gaskets, you will find products specially made to solve your toughest packing problems. Let your nearby R/M distributor help you specify the packings that will assure you of long trouble-free operation. Give him a call today.

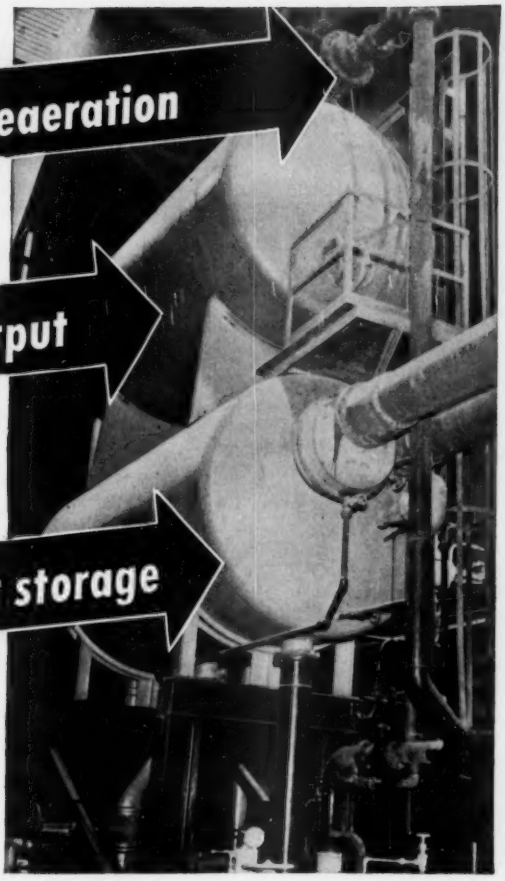
R/M **PACKINGS**

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls



...an example of GRAVER modernizing engineering

When you bring a water treatment problem to Graver, you can be sure of not only authoritative advice and modern equipment design, but more than that . . . *recommendations that consider your pocketbook* . . . the most effective solution at the lowest cost, with savings that may surprise you.

Here's an example.

In 1941, a midwestern steel mill installed a Graver Deaerating Heater, which gave completely satisfactory service for 10 years.

Because of expanded operations and additional boilers, the mill then needed more water heater capacity and storage, and also better quality water. After a careful on-the-spot examination, the Graver engineers incorporated modern internal design to the *existing outer shells* and produced the following results:

	ORIGINAL INSTALLATION	CONVERTED INSTALLATION
Heating capacity	300,000 lb per hr	500,000 lb per hr
Storage capacity	2 minutes	10 minutes
Oxygen in deaerated water	.03 ml per liter	.005 ml per liter

The cost . . . less than 50% of the cost of a new deaerating heater.

Write for advice on *your* boiler feedwater treatment without the slightest obligation and ask for your copy of the new technical article "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater".

GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
216 WEST 14th STREET, NEW YORK 11, N. Y.

GRAVER

GW 487

BIRD & SON, inc.
BIRD PRODUCTS
Established 1795

very much pleased with

Bird & Son, one of the countries outstanding manufacturers of roofing and building materials, linoleum, shipping containers and other paper products, recently modernized their East Walpole power plant by installing a 175,000 lbs./hr. Riley single header hopper bottom pulverized coal-fired boiler unit and a 5000 K.W. generator.

Performance of the Riley boiler unit has been entirely satisfactory. Note comparison of guaranteed and actual results below.

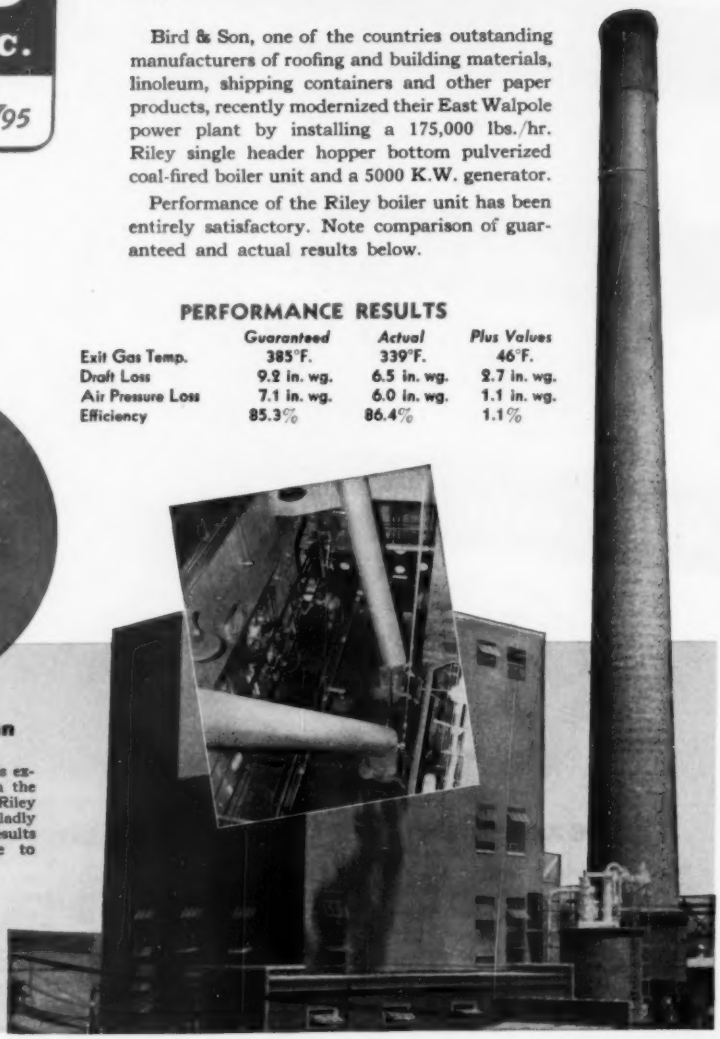
PERFORMANCE RESULTS

	Guaranteed	*Actual*	*Plus Values*
Exit Gas Temp.	385°F.	339°F.	46°F.
Draft Loss	9.2 in. wg.	6.5 in. wg.	2.7 in. wg.
Air Pressure Loss	7.1 in. wg.	6.0 in. wg.	1.1 in. wg.
Efficiency	85.3%	86.4%	1.1%

Robert C. Holman
Plant Engineer

Mr. Holman advises he is exceedingly well pleased with the performance of the new Riley unit. We are sure he will gladly tell you of the excellent results he obtained if you care to inquire.

BIRD & SON, INC.
New Power Plant
East Walpole, Mass.



TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

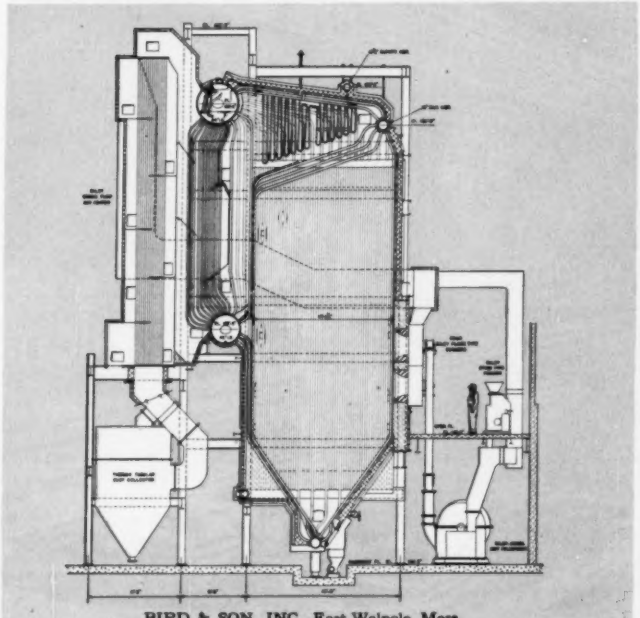
Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

results from their new Riley boiler unit

Riley Single Header Hopper Bottom Units save You money by

1. Reducing height of building required by as much as eight feet
2. Permitting installation of higher capacity unit in existing building
3. Eliminating cost of separate ash hopper
4. Eliminating cost of ash hopper seals and drip castings



BIRD & SON, INC., East Walpole, Mass.
RUST ENGINEERING CO., Engineers
175,000 lbs./hr. 710 lbs. pressure. 750°F. total Steam Temperature pulverized coal-fired single header hopper bottom Riley Units.

108 Riley Single Header Hopper Bottom Units Installed. Total Capacity 17,503,000 lbs. of steam per hour.

All of these well-known Companies have ordered Riley Single Header Hopper Bottom Units.

- *United States Steel Corp.—8 units
- *Esso Standard Oil Co.—5 units
- Chase Brass & Copper Co.
- South Carolina Gas & Electric Co.
- *Pratt & Whitney Co.—7 units
- Western Electric Co.—3 units
- *Monsanto Chemical Co.—2 units
- Norton Company
- Hanna Furnace—4 units
- *Celanese Corp. of America—6 units
- *Regel Textile Corp.—2 units
- American Viscose Co.
- Great Lakes Steel Corp.
- Cluett Peabody Co.
- *Waldorf Paper Products—2 units
- New Orleans Public Service Co.
- U. S. Rubber Co.—3 units
- Continental Can Co.
- Utah Power and Light Co.
- Gould Paper Co.—2 units
- South Carolina Public Serv. Auth.—2 units
- *Syracuse University—2 units
- *Dairyland Power Co-op.—3 units
- *Hooker Electro Chemical Co.—3 units
- Superior Water, Light & Power Co.
- Whippany Paperboard Co.—2 units
- Rayonier, Inc.
- U. S. Finishing Co.
- *Northern Paper Mills—2 units
- Cities Service Corp.
- Calumet & Hecla Consol. Min. Co.
- Otter Tail Power Co.
- Swift & Co.
- C. H. Masland & Sons
- Upper Mich. Power & Light Co.
- Los Angeles Water & Power Dept.
- Champion International Co.
- *Central Ohio Light & Power Co.—2 units

*These companies have placed repeat orders.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

U.S. HOLDTITE FRICTION TAPE
3/4" • 82½ FT. NO.8 ROLL non•RAVELLING MADE TO A.S.T.M. FEDERAL AND PUBLIC UTILITY SPECIFICATIONS
United States Rubber Company

For long-lasting protection

U.S. Holdtite Friction Tape is a wall of safety. A powerful grip . . . high-tensile and high-dielectric strength . . . no pinholes to cause dangerous leaks . . . straight-tearing, non-ravelling. Exceeds A.S.T.M. specifications.

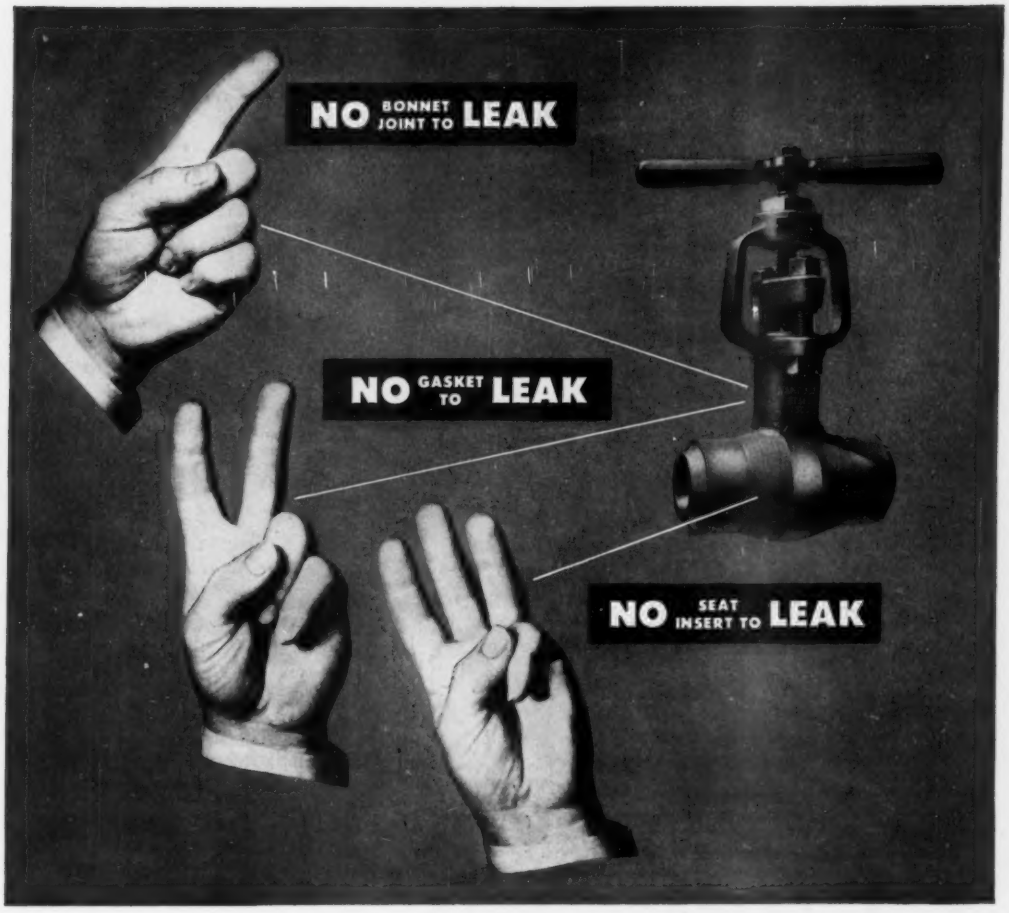
U. S. Holdtite *Rubber* Tape is unbeatable for perfect splicing when used with U. S. Holdtite *Friction* Tape. Both exceed A.S.T.M. specifications.

QUALITY PRODUCTS OF

U.S. RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

TAPE DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, N. Y.



HANCOCK 1500# and 2500# **WELDVALVES** are designed specifically for high-pressure, high-temperature steam plants — are safe, dependable in the severest service. No bonnet joint, gasket or seat insert to cause trouble. The life of the integral stellite seat and disc is permanent. Self-compensating yoke protects seat and disc against wire drawing leaks and damage. No excess weight to create piping strains — compactness saves space. The valve stays in the line for servicing.

Two valve bodies (¾" and 1½") take care of all pipe sizes from ¼" through 2" — simplify inventory and maintenance. Service rating up to 2500# W.S.P. — 1050°F., and 6000# O.W.G. — 100°F.

End the costly hazards of valve leakage. Install safe Hancock WELDVALVES. Call your nearby Hancock Distributor for prompt delivery

When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

SIGNIFICANT STATISTICS ON STEAM

FOR MILLIONS OF NEW KILOWATTS

CYCLONE FURNACES

At the close of 1951, B&W's revolutionary method of coal-firing had been applied to boilers with steam capacities ranging from 65,000 to 1,200,000 lb. per hr.; design pressures to 2125 psi; and steam temperatures to 1050F. Reheat, pressurized furnaces, and gas recirculation were other features in many of these units. Fuels include Illinois and West Virginia coals, lignite, oil and gas. Total steam capacity of all Cyclone Furnace boilers in service and on order is over **19,000,000 lb. per hr.**

HIGH PRESSURES

Since 1926, when central station boiler design pressures entered the now widely specified range over 1400 psi, B&W has been "headquarters" for high-pressure units. At the end of 1951, nearly 300 B&W natural-circulation units designed for pressures between 1400 and 2700 psi with temperatures up to 1100F, and including the world's largest boilers, were in service or on order. In the field *over* 2000 psi, more than 50 B&W units have been ordered since 1937, and 12 of them are in full-scale operation with outstanding performance records.

Power companies have taken advantage of this unique experience in the range over 1400 psi for an aggregate high-pressure steam-generating capacity of **187,000,000 lb. per hr.**

PRESSURE FIRING

Steadily-growing demand for this advanced principle of boiler furnace operation reflects the confidence of power companies in its demonstrated advantages of higher boiler efficiency, lower auxiliary power, and other significant economies. More than a score of power companies now have in service or on order over 75 B&W Pressure-fired units with a total steam capacity of **51,910,000 lb. per hr.**

GAS RECIRCULATION

Applications of the B&W methods of gas recirculation for superheat and reheat temperature control almost doubled during 1951. Over 75 units employing this feature are in service or on order, with capacities ranging up to 1,370,000 lb. per hr., and with all types of firing. Total steam capacity of all units having gas recirculation is nearly **75,000,000 lb. per hr.**

REHEAT

New B&W reheat boilers ordered during 1951 raised the total steam-generating capacity of B&W reheat units in service, under construction, and on order to over **95,000,000 lb. per hr.**

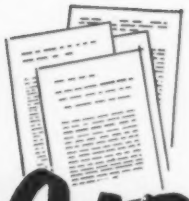
NEW UNITS IN SERVICE

During 1951, power companies placed orders for B&W boilers aggregating over 60,000,000 lb. per hr. of steam-generating capacity. In the same period, B&W central station units totalling 28,000,000 lb. per hr. were placed in service. The unique experience and advanced steam technology reflected in these and other statistics presented on these pages are good reasons why you will want to draw on B&W's vast wealth of research and engineering know-how whenever you are considering additional power generating facilities. Its broad and diversified base assures you the most considerate and unbiased approach to your specific requirements—an approach essential to the most efficient and economical solution of any modern power problem.

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET
NEW YORK 6, N. Y.

G-3581



Service Reports Show that

GARLOCK CHEVRON*

* Reg. U.S. Pat. Off.

SEALS BETTER, LASTS LONGER

than ordinary V-type packings on rams, plungers and reciprocating rods

GARLOCK CHEVRON Packing is entirely different from an ordinary V-type packing. Its distinctive hinge-like construction provides greater flexibility without loss of strength and results in a quicker, positive automatic sealing action.

With increasing pressures Chevron rings tighten and prevent leakage; with decreasing pressures the packing eases off and permits operation with a minimum of friction.

Service reports, such as those at the right, prove that Chevron seals better, needs less maintenance, and lasts longer.

For general applications specify 430 CHEVRON for cold and warm water service; 431 CHEVRON for cold and warm oil; 530 CHEVRON for steam, air or gas; 531 CHEVRON for hot oil. For special applications GARLOCK CHEVRON is made of "Teflon" and other special materials.

Typical CHEVRON Service Reports:

- Oil hydraulic presses packed with ordinary V-type packing. Due to oil seepage down ram special hoods had to be installed to protect operators. Installed all-synthetic rubber type Chevron alternated with Garlock Bitan V leathers. Result-rams are perfectly dry and protective hoods have been removed.
- Boiler feed pump in state institution. Operates average of 6 hours per day—365 days per year pumping water at 212-220 deg. F., 170 psi, discharge, 15 ft. head positive suction. Packed with Garlock 430 Chevron in 1942. Packing still operating efficiently.
- Reciprocating pumps in pipe line pumping stations. Pressures up to 700 psi. Stuffing boxes bushed to shallower depth as only four Chevron packing rings required to handle work performed previously by a much greater number of ordinary packing rings. Maintenance men very pleased with long life of Chevron packing and particularly lack of need for gland adjustment for changes of gravity in the crude oil being pumped.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS

How can we stop heavy scaling in our condenser for process vapor?

HALL LABS

FACTS: Working closely with plant personnel, the Hall Engineers found:

Equipment—barometric condenser pulling slight vacuum on "cooking" vats in which organic material was processed.

Temperature—"cooking" operation close to 200°F.

Water—city water had caused no trouble, but switch to well water resulted in serious deposition of scale. Well water very hard—860 ppm—and high in bicarbonate.

Scale—chiefly calcium carbonate.

Trouble—difficult to control vacuum; shut-downs for cleaning costly, interfered with production.

SOLUTION: Threshold treatment, with a few ppm of glassy phosphate, *at low cost*, stopped scaling.

REMEMBER: Whatever your problems with water for power, cooling, process or disposal, let Hall Laboratories' quarter-century of research and engineering experience help you solve them. Write, wire or call Hall Labs today.

HALL LABORATORIES, INC.

Hagan Building, Pittsburgh 30, Pa.

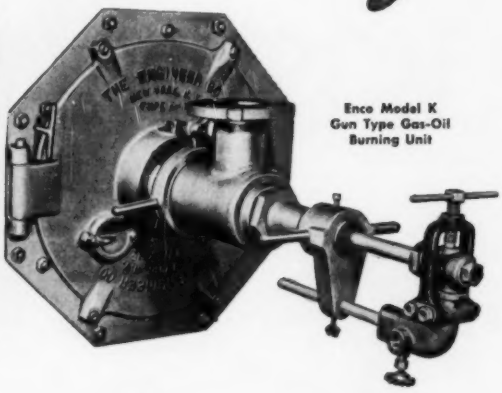
(A Subsidiary of Hagan Corporation)

Consultants on Procurement, Treatment, Usage and Disposal of Industrial Water

Hall Plant Wide Water Service

flexible... 3 ways

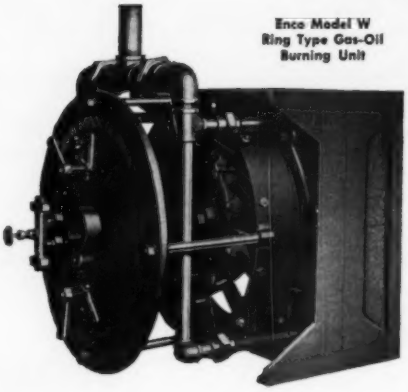
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

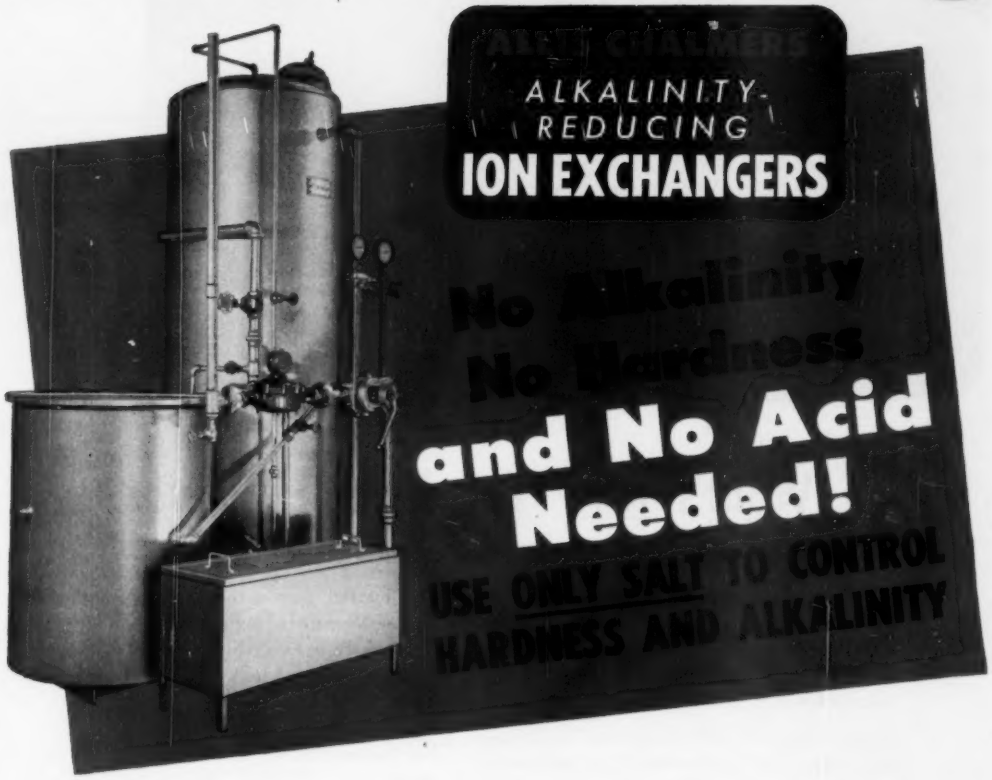
Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.

Enco Standard Range Mechanical Atomizer Gun
Enco Wide Range Steam Atomizer Gun
Enco Wide Range Mechanical Atomizer Gun
Enco Standard Atomizer Gun Support
Enco Gas Burning Gun

EC-489

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK
IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

Announcing



THIS SALT-SPLITTER SYSTEM removes both alkalinity and hardness by means of two resin beds in one tank. Needing only inexpensive salt — no acid — for regeneration, it offers these advantages:

1. Permits operation at alkalinities approaching zero, since no acid is present to damage equipment or produce acid water.
2. Eliminates costly rubber- and lead-lined tanks and piping.
3. Simplifies disposal of spent regenerant.
4. Provides complete safety for operating personnel.

Users of sodium zeolite softeners who find them unsuitable because of the high alkalinity of the effluent or who may be by-passing raw water for boiler make-up should definitely investigate the possibilities of incorporating this system into present installations.

For a concise explanation of the operation of this new combination of two proven water-conditioning methods, get a copy of the new Allis-Chalmers bulletin, 28X7808. Just fill in and mail the coupon.

ALLIS-CHALMERS
Water Conditioning
✓EQUIPMENT ✓CHEMICALS ✓SERVICE

Allis-Chalmers
Milwaukee 1, Wisconsin

Please send Bulletin 28X7808 describing alkalinity reduction by ion exchange.

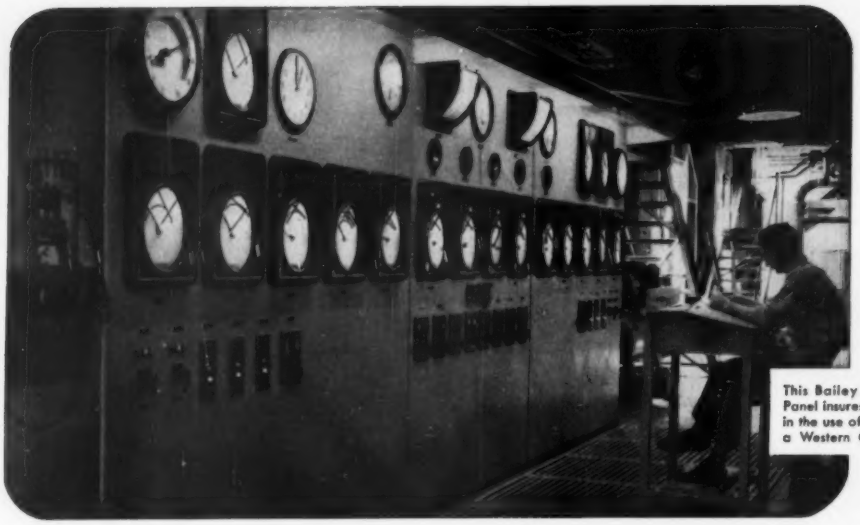
Name .....

Title .....

Company .....

Address .....

City ..... State A-3613



This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

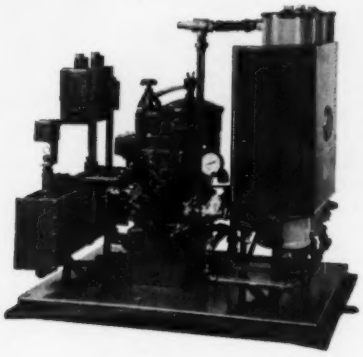
BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

INCREASES OIL LIFE

THE DE LAVAL "PURI-FILTER"



Note these Features

- Removes dirt and water by centrifugal force
- Filters out harmful carbon
- Does not remove valuable additives
- Cleans oil at moderate temperature
- Speeds up inspection—crankcase is cleaner
- Minimizes ring sticking
- Increases bearing life
- Saves labor—long runs without bowl cleaning

INCREASES OIL LIFE

No dirt . . . carbon . . . or water

Because it provides the best means ever devised for keeping diesel oil clean, the De Laval "Puri-Filter" extends the useful life of the oil indefinitely. Centrifugal force, applied within the bowl of a De Laval "Uni-Matic" Oil Purifier first frees the oil of most solid impurities and all water. Then the oil passes through a Fram "Filcron" Filter, which removes colloidal carbon and other minute contaminants.

The De Laval "Puri-Filter" leaves the oil a clear translucent amber color. It is ***visibly*** clean, and thus provides the utmost in protection for every diesel engine.

Used to purify fuel oil, a De Laval centrifuge makes it possible to burn cheaper grades of residual fuel with perfect safety and an appreciable saving of money.

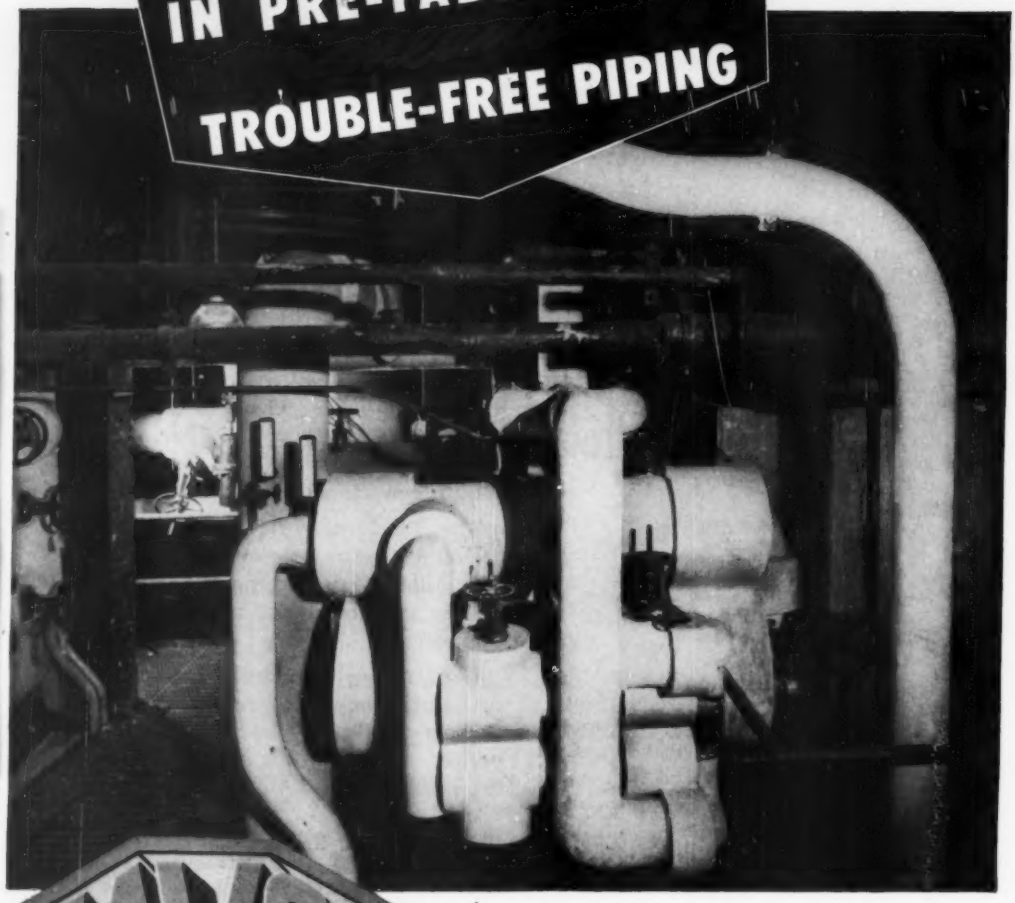
THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL *Oil Purifiers*

FOR DIESEL LUBRICATING OIL

NAVCO ACCURACY IN PRE-FABRICATION

TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

Nalco ARTICLES BULLETINS • REPRINTS Available to You!

MATERIAL listed below is available without obligation as a part of Nalco System service to industry. Information presented is from authoritative sources, factually accurate. Write today, using the coupon below, for data which may be of interest or assistance to you.

CORROSION

1. How Catalyzed Sodium Sulphite Reduces Boiler System Corrosion
2. Protecting Idle Boilers Against Corrosion
3. A Simple Test Method for Evaluating Corrosion Inhibitors
4. Corrosion Manifestations in the Power Plant
5. Scale and Corrosion Control in Potable Water Supplies at Army Posts
6. Scale and Corrosion Prevention by Chemical Conditioning of Water
7. Bul. 45—Nalco Corrosion Inhibitor No. 818C (For preventing corrosion by salt used on streets or highways)
8. Bul. 64—Prevent Sodium Brine Corrosion

COOLING WATER TREATMENT

9. Problems Encountered in the Treatment of Cooling Tower Water for the Prevention of Incrustation and Corrosion
10. A Practical Approach to the Problem of Cooling-Water Slime
11. Correct Stabilizing Treatment Plus Tailored Control Eliminate Scale in Cooling Systems
12. Bul. 33—Treating Recirculating Cooling Water with Nalco 33
13. Bul. 34—Nalco Stabilizing Treatment of Water for Non-Recirculating Systems

WATER TREATMENT FOR HIGH PRESSURE BOILERS

14. Experimental Studies of Iron Oxide Deposits in Boilers
15. Experimental Studies of Boiler Scale at 2500 PSI
16. The Development of Organics for Water Treatment
17. Supply & Control of Water for Steam Generating Stations
18. Conditioning Water for High Pressure Boiler Service
19. Experimental Studies of Boiler Scale at 800 PSI
20. Experimental Studies of Boiler Scale at 1500 PSI
21. Stanoline No. 3 Uses Hot Process on 100% Makeup for 1500 PSI Boilers
22. Use of High Alkalinity and Organic Materials for Sludge Removal in High Pressure Boilers

STEAM QUALITY AND FOAMING

23. Carryover Identification
24. Diagnosis of Carryover Problems by Proper Plant Test Procedures
25. Foaming in Boilers can be Economically Controlled
26. Improvement of Steam Quality
27. Bul. 41—Determination of Steam Quality

PAPER AND PULP MILL WATER TREATMENT

28. Consideration of Microbiological Control in Paper for Food Packaging
29. Alum and Sodium Aluminate in Paper Manufacture
30. Rosin-Size Precipitation and Its Effect on the Sizing and Strength Properties of Paper
31. Slime Treatment Service
32. Progress in Methods of Slime Control
33. Bul. 55—Nalco Chemicals and Services for Paper Mills

ION EXCHANGE

34. Hot Lime Zeolite Proves Practical
35. High-Capacity Cation Exchangers
36. Ion Exchange in High Temperature Industrial Applications
37. Bul. 48—Nalcite HCR (A Resinous Cation Exchanger for Secondary Softening Following a Hot Process Lime Soda Softener)
38. Bul. 57—Nalcite SAR
39. Bul. 58—Nalcite HCR
40. Bul. 59—Super Nalcolite

SOOT AND SLAG REMOVAL

41. Recent Advances in Smoke and Soot Elimination in Coal and Oil Burning Equipment and Diesel Engines
42. Bul. 43—Chemical Removal of Soot from Boiler Furnaces
43. Bul. 46—Nalco Combustion Catalysts SR-150 Soot Remover—SR-155 Fuel Oil Additive
44. Bul. 53—Nalco Fuel Oil Additives SR155—SR158—SR160

MISCELLANEOUS WATER TREATMENT DATA

45. Feedwater Conditioning at the Steel Company of Canada, Limited
46. Prevention of Deposits in Closed Feedwater Heaters and Economizers
47. Highlighting Condenser Leakage
48. Quick Test Determines Dissolved Solids
49. A New Index for Determining Amount of Calcium Carbonate Scale Formed by a Water
50. Aspirin Cures One Water Testing Headache
51. Feedwater Deaeration—Why and How
52. Pioneers in Feedwater Treatment
53. Polyphosphate Stabilization of City Waters
54. Studies on the Cracking of Boiler Plate
55. Bul. 148—The Use of Sodium Aluminate in the Manufacture of Ice
56. Bul. 30—Questions and Answers on Boiler Feedwater Treatment (English or Spanish)
57. Bul. 47—Nalco Internal Treatment of Boiler Water
58. Bul. 49—The Nalco System of Water Treatment for Modern Steam Generators
59. Bul. 51—Nalco Products
60. Bul. 52—Nalco Cuprose for Algae Control
61. Bul. 56—Catalog of Water Testing Equipment
62. Bul. 61—Metallographic Examination of Boiler Steel
63. Bul. 63—The Nalco System for Treatment of Low Hardness Boiler Feedwater

Check and Mail Today

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

Send me the material indicated by the numbers checked above. I understand this is a Nalco service which incurs no obligation on my part.

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

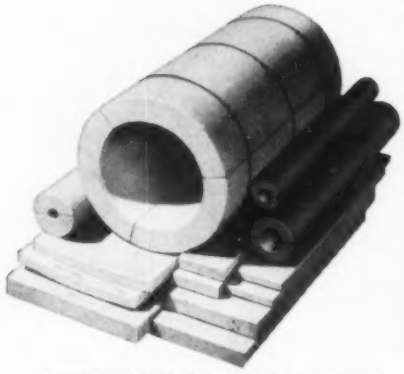
CITY_____ ZONE____ STATE_____

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM . . . Serving Industry through Practical Applied Science

Does Your Present Heat Insulation Have All These Advantages?

Kaylo Heat Insulation is a hydrous calcium silicate—a revolutionary heat-saving material—outstanding both in performance and ease of application.



KAYLO PIPE INSULATION is made to Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when necessary.

1. **LOW "K" FACTOR**—Billions of sub-microscopic air spaces which compose the structure of Kaylo Heat Insulation give it exceptional insulating value.
2. **TEMPERATURE RANGE UP TO 1200° F.**—Kaylo Heat Insulation eliminates the need for combination coverings in nearly all operating conditions.
3. **LONG SERVICE LIFE**—Kaylo Heat Insulation remains dimensionally stable, strong and efficient over the years—although exposed to temperatures up to 1200°F.
4. **INSOLUBILITY IN WATER**—Even when saturated, Kaylo Heat Insulation retains about 85% of its strength. It returns to its original strength after drying.
5. **HIGH STRENGTH**—Breakage of Kaylo Heat Insulation is almost negligible in shipping and installation—workmen can walk on insulated equipment without causing breakage.
6. **LIGHT WEIGHT**—Since Kaylo Heat Insulation weighs only 11 pounds per cubic foot, it is exceptionally easy to handle and apply.
7. **WIDE RANGE OF SIZES AND SHAPES**—Kaylo Heat Insulation's unmatched selection of sizes and shapes reduces the number of pieces required per job.
8. **EASE OF CUTTING AND FITTING**—Ordinary tools of the trade are used to install Kaylo Heat Insulation. The material is non-irritating to the skin and non-toxic.

For complete details on all of the advantages of Kaylo Heat Insulation, write Dept. N-281, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

SEE OUR CATALOG in SWEET'S FILE

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS-ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the card below, detach and mail

TUBING AND ACCESSORIES

101 Condenser Tubes — Excellent factual information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper tube installation are presented, as are specifications, conversion tables, weights of tubes and alloys, formulas, technical terminology. Also included is a picture story covering the production of tubes. Scovill Mfg. Co.

102 Tubing Failures in Severe Service — Factors affecting tube life in high-pressure, high-temperature applications are presented in 40-pp illustrated Bulletin TR-516. Cites results of investigations of failures of carbon steel, intermediate chromium-molybdenum alloy steel and stainless steel tubing in boilers, cracking stills, heaters and heat exchangers during service at elevated temperatures and pressures in the power, oil and chemical processing fields. Tells history and experience behind contemporary development of high-temperature tubing. Tubular Products Div., The Babcock & Wilcox Co.

103 Tubes All Fouled Up? — A positive air-driven rotary shaft drill type tool for scavenging heat exchanger tubes with air or water is described and pictured in Bulletin TW-1046. Stresses power, light weight and increased capacity of cleaner. Thomas C. Wilson, Inc.

104 Tube Benders — Bulletin 2001-A features a "2-in-1" bender which bends both ¾- and ⅝-in. ID tubing. Also gives data on other tubing service tools. Includes sizes, prices. The Imperial Brass Mfg. Co.

105 Tube Fittings — New Catalog 4300, 76 pp, combines in a single volume complete data on tube fittings and tube-to-pipe adaptors, fabricating equipment, and pertinent data on engineering selection and installation. Illustrations and dimensional tables are included for all shapes of company's Triple-lok standard three-piece flared fitting, the Ferulok flareless fitting, precision machined pipe fittings, and tubing, tube clips, cutters, benders, flaring tools. Data section includes "how-to-do-it" photos, charts relating tube sizes to velocity, flow, service conditions, allowable stress, temperatures and pressures. The Parker Appliance Co.

ELECTRICAL

106 Meter Socket Selector — Booklet B-5284, an easy-to-use 18-pp text, is so designed that user needs only initial information on type of service desired and wire size to be used in order to determine proper type meter socket. The type having been determined, detailed information, conveniently indexed, is available. In addition to describing each type, the Selector gives data on circuit closing provision, terminals, service disconnects, ordering and determination of style number. Also included are reference wiring diagrams, dimensions and auxiliary parts data. Westinghouse Electric Corp.

107 For Isolating High-Voltages — Bulletin 140 is a 40-pp ordering guide and manual covering manufacturer's "Isolator," a device for providing a means of disconnecting and isolating high voltage electrical equipment. Explains how Isolator works, how it saves space, materials and installation labor and prevents accidents. Dimensions given for single- and double-throw Isolators and Cable Isolators. Typical installations are pictured, also use of these devices for grounding circuits and as terminal connectors. Also includes mounting details, data on control mechanisms, replacement parts. Electrical Engineers Equipment Co.

108 Electrical Fittings Guide — Catalog 1050, 12 pp, describes a line of solderless wire connectors, cable and conduit fittings and wiring devices. Contains well illustrated descriptive information on company's Free-Sure-Connectors for solderless wire splicing and terminating, both plain and insulated conduit bushings, box connectors, conduit locknuts, knockout plugs, terminal blocks. Includes specifications, dimensional data. Buchanan Electrical Products Corp.

109 Data on Limit Switches — Here are three single-sheet bulletins offering descriptive and application information, ratings, photos and dimension drawings of limit switches. Bulletin GEA-5704 covers the rotating type limit switch for use where reversing operation is to be co-ordinated with the number of revolutions of a motor shaft or driven equipment. Bulletin GEA-5705 describes lever-type limit switch for use where it is desired to make or break a control circuit at a point in the travel of a machine part or mechanism. Bulletin GEA-5707 is on track-type limit switch, with interchangeable operating heads. State bulletins wanted. General Electric Co.

110 Enclosed Motors — Construction features and details of totally-enclosed, fan-cooled motors with tube-type air-to-air heat exchangers in ratings from 40 hp at 600 rmp through 800 hp at 3600 rpm are described in Bulletin 51B749B. Points out that these motors come in standard and explosion-proof designs, the former for applications without explosion hazards but requiring protection of windings from dust, fumes. Allis-Chalmers Mfg. Co.

111 Loads Outgrowing Conduits? — "Rx for Rewinding" is a 12-pp booklet offering a practical and economical solution to the problem of caring for electrical loads which have outgrown their conduits. Shows how use of company's AVC can increase conduit capacity without increasing conduit size. Describes construction of AVC, tells how to estimate costs of wiring, gives sizes. Includes selection tables covering allowable current carrying capacity, minimum conduit sizes. Rockbestos Products Corp.

Use this CARD for information on ADS and NEW PRODUCTS also

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P.L.&R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS

PLEASE PRINT OR TYPEWRITE

March 1962
Card Void in 7 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

.....
.....
.....
.....
.....

Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill below)

Home Address.....

City.....State.....

Also, use this card for more information on advertised products

112 Motor Control Center — The easy installation, accessibility, versatility and special construction features of company's new motor control center are covered by text and photo in 24-pp Bulletin GEA-4979A. These control centers are pre-engineered, factory wired and assembled units for use where two or more a-c motors (up to 200 hp, 600 v) are controlled from a central location. Booklet discusses short circuit protection afforded, pictures arrangements of vertical sections. Also provides reference and selection charts, specifications, instructions for planning installation. General Electric Co.

PUMPS, COMPRESSORS

113 Centrifugal Pump Pointers — Bulletin 08X7613 is a 30-pp instruction booklet covering the installation, operation and repair of manufacturer's single-stage double-suction centrifugal pumps. Recommends a regular inspection to be followed and includes a maintenance timetable based on continuous pump operation. A page is for use as a permanent record of the operator's pump and its performance. It is so arranged as to enable operator to see at a glance the life of any parts replaced and any improvement due to substitute materials. Also carries a quick reference guide listing 40 possible causes of trouble in pump operation and their cures. Allis-Chalmers Mfg. Co.

114 Rotary Compressors — Bulletin C-1 is company's most recent on rotary compressors. Fully illustrated, provides sketches of intake regulator, and bearing and ring assemblies, also photos of installations. Explains operation. Fuller Co.

INSTRUMENTS AND CONTROLS

115 Money-Saving Meters — Sixteen-pp Bulletin GEA-5727 stresses ten ways that company's I-50 watthour meters reduce operating expenses. Outlines possible savings that can be realized by utilities through use of these meters. Estimated savings are based on studies of meters' characteristics, construction, design and operation. General Electric Co.

116 Composite Catalog — Illustrated Catalog 5000, 28 pp, describes principal instruments, control devices and related components manufactured by company's industrial division. Specifications of 100 measuring and control instruments, and valves are outlined. Included are new designs, the differential controller and Tel-O-Set controller family. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

117 Electronic Transmission, Control — Data Release A-703 is a 6-pp brochure explaining company's Autronic principle and how the Autronic control system utilizes electronics for automatically measuring and controlling process variables such as temperatures, pressure, level and flow. Punched for filing, booklet illustrates components of the system, shows a unit installation. A system circuit diagram is included with a discussion of a typical application. The Swartwout Co.

118 Guide to Efficient Combustion — Instrumentation Data Sheet 10.15-3a describes the Davis indicating and recording flue gas analyzer which utilizes a thermal conductivity gas analyzer in combination with a Brown Electronik recorder, to provide continuous recorded combustion analysis. Explains how equipment is built, operates and is used. Illustrated with photos, diagrams. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

119 Temperature Controls — Catalog 400, 52 pp, on Thermoswitch controls describes the design, operating characteristics and installation of 10 variations of manufacturer's basic thermostatic device. A section on selection and application discusses operating differential, sensitivity, temperature variation, lag and overshoot, frequency of switching, other aspects. Fully illustrated with photos, graphs and tables, other sections cover reason why this switch is sensitive only to heat, modifications, special features. Dimensions, thermal and electrical specifications given for both standard and heavy-duty types. Fenwal Inc.

120 Control Thermometers — Specification Sheet 609 describes manufacturer's Electr-O-Vane control thermometer, having snap-action electronic control. Illustrates indicating, single- and two-record types; discusses control unit, assembly variations, control forms, bulb and tubing. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

121 Filter Gages — Bulletin 450-H10 describes company's line of filtering gages, explaining their principle of operation. The diaphragm pendulum unit used in many of the gages is discussed. Gage specifications included, typical installations sketched. Builders-Providence, Inc.

122 Pressure Controller — A new non-indicating pressure controller, the Honeywell Pressure Pilot, is described in 8-pp Bulletin 16-1. Covers the controller's principle of operation, specifications, design features, mounting dimensions, other information. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

123 For pH Determination — Eight-pp Folder EM9-96 introduces a modern line-operated pH indicator with high stability, permitting readings with ± 0.02 pH on grounded or ungrounded solutions. Covers applications, design features, operation, also electrodes and buffer solutions. Gives specifications. Leeds & Northrup Co.

124 Radiation Instruments — Eight-pp Bulletin GEA-5735 covers ten recent nuclear radiation detectors for industrial and other applications. These include a radiation monitor, portable radiation probe, thermocouple vacuum gage, step-motor impulse counter. General Electric Co.

PACKINGS

125 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. These, in turn, are illustrated with close-up photos and construction information, sizes etc. Packings and gaskets are grouped on the pages according to recommended applications and services. Where packings have more than one application, cross-references are supplied. Johns-Manville.

126 Metallic Packings — This 8-pp bulletin on flexible metallic packings provides descriptive data, service recommen-

(*Continued on page 105*)

Use this CARD for information on ADS and NEW PRODUCTS also

PLEASE PRINT OR TYPEWRITE

March 1952
Card Void in 7 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

....
....
....
....
....

Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill below)

Home Address.....

City.....State.....

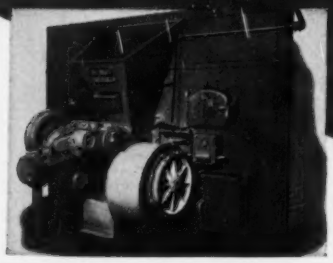
Also, use this card for more information on advertised products

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P. L. & R.
CHICAGO, ILL.

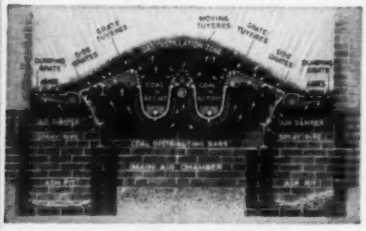
BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS



TROIT UNISTOKER Single retort underfeed
th Adjustable Coal Feed Control.



TROIT DOUBLE RETORT A multiple retort—
e cleaning underfeed for medium sized
lers. No basement required for ash removal.

for any steam generator

including package types

use DETROIT STOKERS

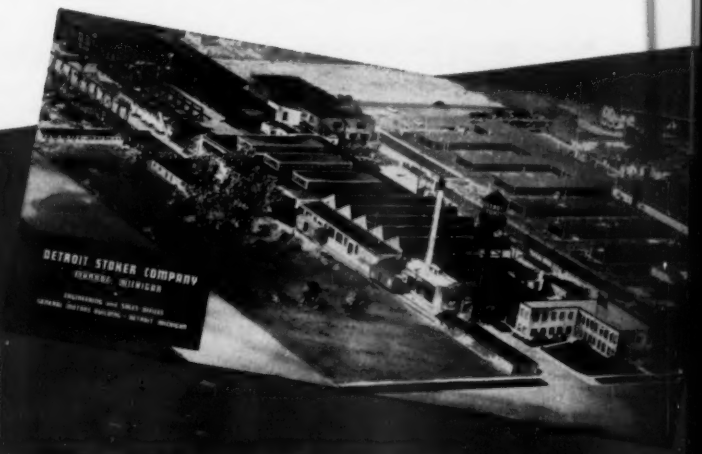
We build stokers adaptable to any type or make of boiler or steam generator. No matter what you are considering we can furnish the ideal stoker—the one that fits the furnace and is best suited to your operating conditions.

Detroit Stokers are successfully operating in thousands of boilers of different types, from firebox heating boilers to large steam generators of over 300,000 pounds of steam per hour, capacity. They are installed in private and public institutions, buildings, industrial and power plants, here and Abroad.

Assembled and Inspected In Our Plant Before Shipment

Each stoker that we design and build is assembled by experts in our plant and carefully inspected prior to shipment. You can't go wrong with Detroit.

Built to outlast the boilers that they serve, Detroit Stokers give you the best, most economical firing method for your needs. An informal discussion with one of our Engineers will cost you nothing and might save you a lot. May we hear from you?



DETROIT STOKER COMPANY

DETROIT STOKERS

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities . . . Works at Monroe, Michigan

how 93,360 miles of Republic Rubber roadbed shortened a 1,378 foot journey!!

●Out of the sawmill, over a pond, under a railroad track, up a hill—1,378 feet all told, and with a back-breaking load of raw lumber . . . it's quite a journey.

For more than 10 consecutive years the same Republic Conveyor Belt has been making this trip for the Bradley Lumber Company, Warren, Arkansas.

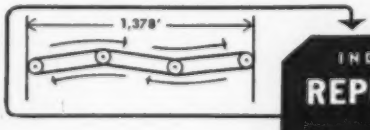
At 400 ft. per minute, that's 93,360 miles of traveling—more than 275 million feet of rough, green lumber moved from sawmill to sorting chain, where each plank is graded according to length, width and quality.

Some say this is the longest green lumber conveying belt in the world. But that's hardly the point.

Think of the labor that's saved here! Consider that what was once a long, muddy road is now a compact smooth-flowing production line, subjected to the most rigorous work conditions, yet always moving, rain or shine. One man, a toggle-switch and a 15 H. P. motor is all that's needed to control the entire operation.

Republic Conveyor Belts handle tough loads like this for every type of industry. Rock, metal, liquids, chemicals, foods . . . *almost anything you can name, heavy or light, hot or cold* . . . all travel more efficiently and economically on Republic Conveyor Belting!

Your local Republic Distributor can help you select the belt designed for your particular work and give you accurate information regarding costs, performance figures, etc. Contact him today or write direct for full facts.



INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO

STANDARD HD
TRADE MARK
OIL

Solves a diesel maintenance problem

● Excess cylinder and ring wear plus sludge, varnish, and carbon deposits posed a costly maintenance problem for operators of this municipal power station. Overhauls were scheduled every six months. A full set of rings was installed at every overhaul. That was the situation in 1947 when a Standard Oil lubrication specialist recommended changing to STANDARD HD Oil.

The change was made on one of the station's five diesels. These are the results with STANDARD HD.

Time between overhauls has been doubled, and normally only the two top rings are changed. Cylinder wear has been cut to a minimum, even with the engine operating under heavier loads. The engine has remained clean and there has been no ring sticking. Efficiency has been stepped up from an average of 12.0 KW per gallon of fuel to 12.5 KW per gallon.

These results, the solution of a costly maintenance problem, have led to the use of STANDARD HD Oil in the station's four other diesels. Chances are that a Standard Oil lubrication specialist can help you achieve similar results in the operation and maintenance of your own diesel equipment. Put him to work on your problem today. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD *(Indiana)*

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-paid card on pages 37 and 38 for your request. Just list the numbers of the items you'd like to know more about

1 — 2-IN-1 TUBE BENDER

Bends both ½ and ⅝ in. OD copper, aluminum, brass tubing

For use on any thin, soft-walled metal tubing, this combination bender has a dual size shoe and mandrel to permit bending two different sizes of tubing without changing parts. The bender is of two piece construction; it comes apart and slips over the tube at the point where the bend is needed. Thus it can be used to bend tubing where one end is connected as easily as that which has both ends free. Bends can be made to any angle up to 180 deg and bender is calibrated to show degree position. It's made of steel and aluminum, weighs 3 lb. The Imperial Brass Mfg. Co.

2 — "PLASTIC" BATTERIES

Are light, compact, transparent; available over wide capacity range

This new line of plastic-cased batteries for use in alarm systems, power-plant control systems, and other applications where batteries are used for stand-by

emergency power, are available in capacities from 8 amp-hr to 100 amp-hr (8 hr rate of discharge).

According to manufacturer, the polystyrene containers offer several advantages over many of the previously used containers: They are appreciably lighter in weight and smaller in size; they have improved shock resistance; they do not react with the electrolyte and being transparent, they show the electrolyte level; the styrene material is more readily available and containers can be made from it faster. Gould-National Batteries, Inc.

3 — VOLT AMMETER

Measures to 1200 amp; can fit into coat pocket or briefcase

Like its predecessors, the Amprobe 1200 is of the "snap-around" type designed to measure current instantly without being connected to the conductor. The reading can be taken without interrupting the circuit or shutting down equipment.

Six important engineering and design features are announced for the new model. It uses a new doughnut-type transformer said to virtually eliminate factor of error due to position of conductor within probe jaws; it incorporates six ammeter ranges and three voltmeter ranges (0/15/60/150/300/600/1200 amp a-c. and 0-150/300/600 v a-c); voltage test leads have a new type plug designed to automatically insulate itself when removed from the meter; probe jaws are insulated down to the sockets, and a wide-angle window is provided.

The Amprobe 1200 is 8½ in. long, weighs 15½ oz, costs $67.50, including leather case and test leads. Pyramid Instrument Corp.

4 — AIR HOSE

For jack hammers, concrete busters, other pneumatic equipment

Designed to prevent accidents caused by pneumatic equipment coming into contact with hidden power lines, Invincible Air Hose has its protection built in. Its specially engineered braided copper ribbon of 832 strands forms a high current-carrying medium which is bonded in the actual carcass of the oil-proof, abrasion and heat-resisting hose, manufacturer explains.

Besides providing increased safety for operator, this hose is said to outlast many types of air hose and to withstand heavy-duty working conditions. It is available in ½ in. ID sizes, in 4- and 5-ply construction. Mercer Rubber Corp.

5 — PROCESS PUMP

For petroleum hydrocarbons, water, chemical solutions

Intended for high temperature and pressure applications, the Type PR Pump provides capacities to 1000 gpm and operating heads to 625 ft. Company says it can be used for pumping liquids up to 850 F. Horizontal electric motor drive is standard, but others such as steam turbine or stationary engine can be furnished. The pump's liquid end can be cast iron, bronze, carbon steel, stainless steel or other materials; two models are offered, one with top suction, top discharge and the other with end suction and top discharge.

New construction features incorporated in the pump include centerline mount design to maintain pump alignment at any temperature and positive support beneath the pump case to prevent strains on rotating parts. Internal joints have been eliminated where differential pressure across them would cause leakage or corrosion. Peerless Pump Div., Food Machinery and Chemical Corp.

6 — BOILER "DOG HOUSE"

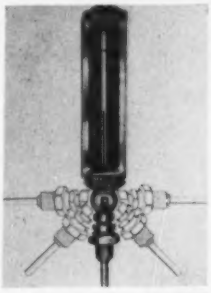
For outdoor installation; protects vital working parts, keeps them accessible

While most boilers are installed inside buildings such protection is not entirely necessary to their operation, says this company, adding that their steam generators have done temporary outdoor duty while boiler rooms were under construction or renovation. Now, some generators have been built especially for outdoor installation, and to cover vital parts a special housing, referred to as a "dog house" has been designed. This housing makes working parts accessible, and includes power lockouts to prevent operation when an engineer is in the enclosure. Construction of this enclosure is described as simple and watertight. Superior Combustion Industries, Inc.

7 — THERMOMETER

Adjusts to any angle to cope with thermometer installation problems

The Adjust-Angle Thermometer is designed for positioning at any angle through a 180 deg arc, back or front,



left or right. According to company it affords greater visibility at all times, eliminates breakage of tubes due to shock or vibration, besides saving hours of blueprint study in the selection of angles required on thermometers in the design of new equipment.

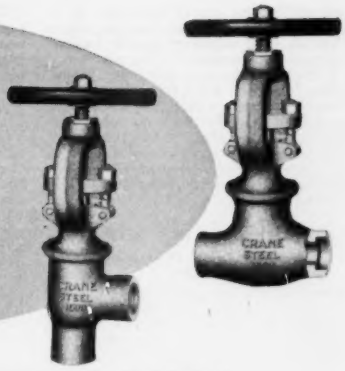
Unique feature of the Adjust-Angle is its use of a flexible metal capillary within a specially designed ball connection, which permits adjustment of stem or case to desired position. Manufacturer says this is made possible by the positive fusion of the metal capillary and the glass members of the unit to result in an instrument that will withstand angle changes without injury to thermometric system. Weksler Thermometer Corp.

8 — MAGNETIC CONVERTER

For converting low-level d-c error signals to a-c voltage

For use in a wide variety of measurement systems, this new magnetic-amplifier-type device weighs only 3 lb, and is

NEW CRANE
SMALL STEEL VALVES
WITH *REVOLUTIONARY* LIP-SEAL
(PATENTED)
BONNET JOINT
1500 AND 2500-POUND CLASSES



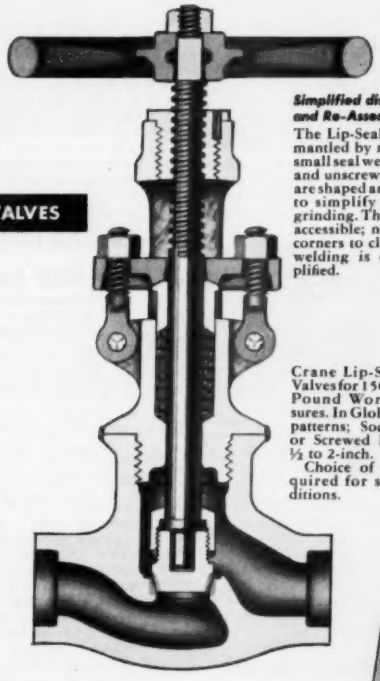
Look closely at the Lip-Seal Bonnet joint of this new Crane small steel valve. A small bead of weld metal seals the joint against leakage—yet the entire mechanical load, both pressure and stem thrust, is carried by strong threaded members.

Here is bonnet joint improvement that brings you important benefits beyond tight sealing and freedom from maintenance.

For example, Crane Lip-Seal design permits a weight-saving, more compact structure without sacrificing strength or reducing seat area. It combines significant developments for improved flow control, ease of operation, and durability. Add to these the ease with which the Lip-Seal joint may be dismantled and re-assembled—and you have a valve with outstanding suitability for your high-pressure/high-temperature power service needs.

DESIGNED AND TESTED TO GIVE YOU:

- **Absolute Tightness**
- **Freedom From Bonnet Joint Maintenance**
- **Minimum Weight and Bulk**
- **Easier Dismantling and Re-Assembly**



Simplified dismantling and Re-Assembly

The Lip-Seal joint is dismantled by removing the small seal weld on the lips, and unscrewing. The lips are shaped and positioned to simplify removal by grinding. They're entirely accessible; no pockets or corners to clean out. Re-welding is equally simplified.

Crane Lip-Seal Bonnet Valves for 1500 and 2500-Pound Working Pressures. In Globe and Angle patterns; Socket-welding or Screwed Ends. Sizes: ½ to 2-inch.

Choice of Steel as required for service conditions.

YOU GET FEATURES LIKE THESE IN LIP-SEAL VALVES

SWIVEL DISC-STEM CONNECTION—Minimizes vibration—provides long pilot guiding for disc. Design makes a more rigid—yet swivel-free—connection.

FULLY GUIDED STEM—Smoother, easier to operate. Fully guided by long yoke bushing and long engagement with lower end of bonnet. Gives positive, straight-line seating.

TWO-PIECE BALL-TYPE PACKING GLAND—Assures uniform load on packing. Prevents binding on stem even when nuts are not pulled up equally.

DURABLE PLUG-TYPE DISC—Has wide seating contact not easily damaged by foreign matter or by wiredrawing. Taper of disc permits close flow regulation while throttling.

STELLITE-FACED SEATING SURFACES—Effectively withstand corrosion and erosion; highly resistant to wear, seizure, galling, and abrasion. Seat is integral with body.

EASY ACCESS TO STUFFING BOX—Ample space within yoke legs allows convenient re-packing. The swinging type gland eye-bolts swing completely clear.

This Circular Ready For You

Your copy of this 8-page booklet supplied free on request. Gives complete information on Lip-Seal Valves, including materials, service recommendations, sizes, and dimensions. Ask your Crane Representative for a copy or write direct.

The Complete Crane Line Meets All Valve Needs. That's Why,
More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

encased in the metal envelope of a standard 6L6 radio tube. Company says it can be used wherever precise control is required from small d-c signals.

● Company engineers developed it primarily for use on 400-cycle power giving a double-frequency output of 800 cycles, but say it may be used on other frequencies by selecting a suitable value of external capacitor which tunes the output. Converter is hermetically sealed, has six terminals for connecting leads. General Electric Co.

9 — COMPLETE RING SETS

For large bore diesels; are made up in cylinder units

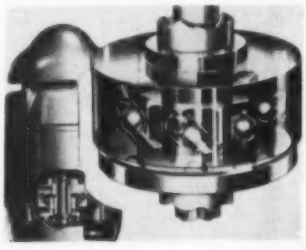
Now available for diesel engines of large bore are Pedrick Engineered Ring Sets, complete installations designed for long service, minimum oil consumption and high power output. These sets are said to incorporate latest design features, especially in the flexible or conformable oil rings, for each particular type of big-bore engine. Each set applies to only one model of engine, and the sets are made up in cylinder units to facilitate ordering for any of the multiple-cylinder combinations. Wilkening Mfg. Co.

10 — BACKSTOP

To prevent reversal of company's vertical hollowshaft motors

When electric motor current ceases, a vertical turbine water pump back-spins unless means are provided to prevent motor reversal and avoid damage to pump bearings. The Ballomatic Backstop utilizes balls to make use of natural laws to provide quick-engagement and strength.

When the motor starts, centrifugal force throws the hardened steel balls out of engagement with the stationary member. When the motor stops, gravity



pulls the balls down and one of them engages between the rotating member and the stationary ratchet to prevent reversal. The backstop is designed with a different number of balls and ratchet flutes to multiply the possible number of locking positions in one rotation and thus reduce impact and wear. U. S. Electrical Motors, Inc.

11 — OVERLOAD RELEASE

For speed reducers; to protect driven machine and motors

An overload release for company's Torque-Arm Speed Reducer which is designed to prevent breakdowns resulting from excessive loads on the equipment, this new product is named the Tri-Matic Overload Release because of the triple protection it offers. It operates mechanically and electrically to (1) loosen belts, (2) cut off current, and (3) activate a warning bell, siren or light.

The release acts instantly, company explains. Pressure exerted by an excessive load causes a piston to move lengthwise through the unit and this movement loosens the belts and cuts off the current simultaneously. The warning system is hooked up to the Micro Switch. The Tri-Matic is calibrated for adjustment to load conditions of any job, and can be set to act at any desired load up to reducer's maximum capacity. To reset the Tri-Matic after it has been tripped, the speed reducer is pulled back manually into position and this automatically cocks the overload release mechanism.

This new unit replaces the standard torque-arm regularly furnished with company's speed reducer and is interchangeable with it. It will be available for either single or double reduction types. Dodge Mfg. Co.

12 — STEAM GENERATOR

Packaged type, is automatic, self-contained unit, simply designed

Simplicity in construction is stressed in the new Continental Packaged Steam Generator, said to be easily installed, efficient, and economical to maintain. The generator is available for use with heavy or light oil, gas or a combination, and in sizes from 10 to 500 hp, for 15 to 200 lb operating pressure.

The Continental is described as an improved two-pass version of the Scotch marine type boiler. To provide for maximum heat transfer and low flue gas temperature, all fuel is burned in the water-surrounded boiler furnace, and the gases pass spirally through large 3-in. tubes. The only refractory required is at the back of the boiler. A dry pipe in the boiler removes condensate from the steam to keep moisture content low, it is pointed out, and the steam tends to remain dry because a constant water level is automatically maintained. Boiler Engineering and Supply Co.

13 — STRIP CHART RECORDER

Independently powered; has electronically actuated pen

The compact Autronic Recorder, graphic indicator for company's Autronic Control System is an electronic servo-powered null-balance device for providing an accurate and instantaneous record of measured variable. Unbalance between output or primary element transmitter and balancing transformer is amplified to drive the rotary solenoid motor for positioning the pen.

At maximum speed the pen traverses the chart in about ½ sec; it is noted that slowing down pen doesn't reduce recorder's sensitivity. The pen, electronically actuated, independent of chart drive, measures and records over the range of 0.0 to 0.500 v a-c.

This recorder is designed to give a linear trace by passing the chart over the right-hand edge of the chart plate which is formed into a convex arc, the radius of which is equal to the 8 in. radius of the pen arm. The pen then traces on this narrow edge of the chart. Since the recorder has plug-in connections, the entire unit can be removed from the circuit; also the recording mechanism can be pulled out a few inches from the case for inspection of past records without stopping the recorder.

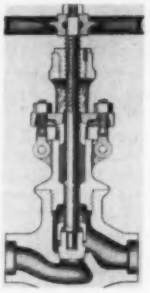
Measuring only 4⅝ in. on the control board or graphic panel, the Autronic Recorder is enclosed in a metal housing which slides into a metal mounting frame 14⅛ in. deep. Three hr of records are visible through the glass windowed door. Standard speed of the 3 in. wide chart in 1 in. per hr. The Swartwout Co.

14 — BONNET JOINT VALVES

Feature lip-seal design for tightness, minimum weight and bulk

A new line of small steel valves for high-pressure, high temperature services are available in globe and angle patterns in both 1500- and 2500-lb pressure classes. These valves are suggested for use on main steam, auxiliary steam, boiler feed and other piping, for drips, drains, by-pass, blowdown and similar services.

Their distinguishing feature is the lip-seal bonnet joint designed to provide absolute tightness and freedom from maintenance, yet be easily dismantled and reassembled. The joint consists of long body-bonnet threads which are



pulled up until contact is made between flat surfaces on the shoulder of the bonnet and the top of the body. The small lips around the edge are then seal welded.

These valves also have a new disc-stem connection designed to retain the swivel feature but eliminate avoidable looseness of parts. Seating surfaces of plug type seat and disc are faced with Stellite and seat is integral with body. The valves come in ¼ to 2 in. sizes, with either socket-welding or screwed ends. Crane Co.

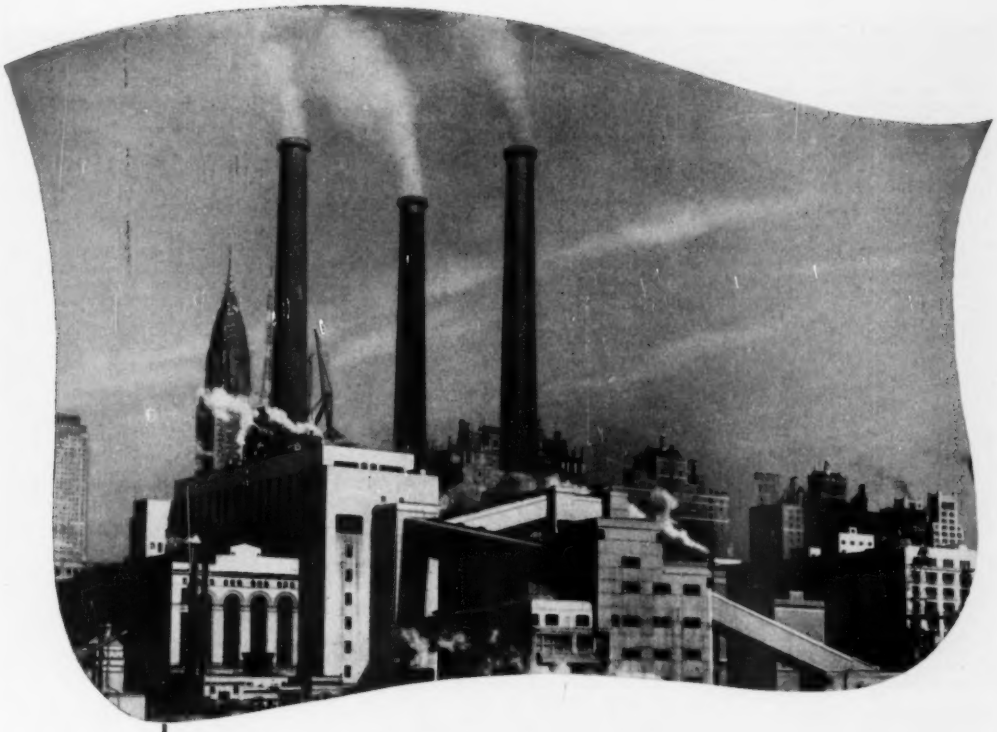
15 — SURFACE REINFORCEMENT

For concrete floors that take heavy loads, severe punishment

Available in limited supply is Floor Plate, an 11¾ in. square plate of 0.068-in. hot-rolled steel. Floor Plate can be installed as a new surface or over old floors. Each plate contains 100 small rectangular holes (about ½ by ¾ in.) and 100 barbed prongs, ¾ in. long, which anchor the plate to the concrete 100 times per sq ft. The four rounded edges of each plate form a flange that becomes imbedded in the concrete and adds rigidity to the plate.

Area-wise the surface of a concrete floor so reinforced is 74 per cent steel and 26 per cent concrete, so that steel is always under the wheels of traffic. Floors protected with this plate are described as safe, wet or dry, because the abrasive characteristics of the exposed concrete provide resistance to slipping.

For new floors a dry concrete topping mix is poured over the base slab and screeded, then the plates are pressed into the topping until pillows of concrete extrude upward through the holes. Plates



Whatever equipment you prefer, here's the secret of

LOW-COST POWER

When choosing your fuel, always keep these three factors in mind:

1. ***The types available.*** Along the Baltimore & Ohio, you're sure to find the type that exactly meets your needs. The modern mines in this area produce a wide variety of excellent Bituminous.
2. ***Nearness to your plant.*** With its 11,000 miles of track, the B&O offers efficient economic transportation to plants throughout the heart of industrial America.
3. ***Reserves on hand.*** Virtually limitless reserves of power-packed Bituminous lie in the vast B&O territory—a supply that will last for centuries.

For the secret of dependable, low-cost power as related to your specific needs, *ask our man!*

Bituminous Coals for Every Purpose

LINKING 13 GREAT STATES WITH THE NATION — B&O

BALTIMORE & OHIO RAILROAD

Constantly *doing things*—**better!**

are then leveled with floor surfaces and finished. Old concrete surfaces first require chipping and a slush bond surface before the topping mix is poured. It is noted that any plate or combination of plates may be removed without disturbing the rest of the floor when repairs must be made to pipe lines, electrical lines etc. Acme Steel Co.

16 — LABELING TAPE

Is pressure sensitive; you can write or type labels as needed

Labelon Tape is for making waterproof, oilproof and smudgeproof labels. It is made of two layers of acetate with a white waxy substance laminated in between. Press on the top layer with a pencil, stylus or other blunt instrument, and you expose the bottom colored layer to view — like a child's "magic slate" toy. Flick the typewriter ribbon to "stencil" and you can type your labels.

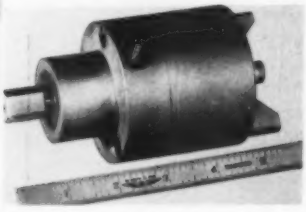
Company says the adhesive sticks to glass, wood, metal, plastics, ceramics — almost any hard surface — and can be transferred from one surface to another without leaving a sticky residue. It is said to adhere and remain legible from −40 to 160 F, and not discolor or curl with age.

Labelon comes in black, blue, red and green, in five widths from ½ to 1½ in., in 400- and 800-in. rolls, in suitable dispensers. A ½ in. width comes in red only, and a 2 in. width in blue. Labelon is also available with printed information and space for writing in variable information, a combination suggested for parts indentification, special circuit labeling. Labelon Tape Co.

17 — COMPACT PUMP

For handling light viscosity fluids; has rolling vanes

The new Magna-Mite is a low-priced positive-displacement pump of compact size. With a capacity from 1½ to ¼ gpm or less, this pump is suitable for fuel oil, gasoline, hydraulic fluid and lubricating oils. The Magna-Mite is generally similar to vane-type pumps, but is different in that the conventional vanes are replaced by rollers. These rollers contact the outer case as in a roller bearing, and rolling friction re-



places sliding friction between vanes and pressure chamber. As a result, company states, the life of the pump is greatly increased.

The pump is cylindrical in shape, is 2¾ in. dia, 6 in. long. It is available in three major types: Type A, constant displacement; Type B, adjustable displacement, and Type C, variable and reversible. The pump is furnished as standard with diametrically opposed ports have a ¼ in. pipe thread. A practical speed range of 300 to 3600 rpm is announced for the pumps, and they are rated at 1750 rpm. Milwaukee Hydropower, Inc.

18 — SMOKE CONTROL

A photoelectric system to check on smoke density

This smoke control system consists of three units: a light source, a photoelectric cell whose output is proportional to density of the smoke, and a master control with amplifier, relay, smoke density meter calibrated in Ringelmann units, and signal lights.

The light source and photoelectric cell units are mounted on opposite sides of the breeching or smoke chamber, centered over 2-in. holes in the breeching walls. The master control, which may be remotely located, can be set for a predetermined smoke density. The indicator responds to any variation in density, company states, and a non-adjustable time delaying circuit permits a small amount of smoke to pass before starting the control, to eliminate cycling of equipment. Standard units are available for 110 v or 220 v 60 cycle current. Cleveland Fuel Equipment Co.

19 — TEMPERATURE REGULATOR

Features design simplicity, has visual finger-tip dial control

Control accuracy of ± 1 F is claimed for the Type 1005 Regulator, obtained by means of a balanced, single-seated pilot operating on a vapor flash principle. It is pointed out that 99 per cent of the power to position the valve is taken directly from the steam, only 1 per cent from vapor expansion in the thermostatic system.

This regulator is self-contained and pilot operated in sizes 2 in. through 4 in.; it is available with 125 lb or 250 lb ASA flanges for steam pressures from 10 to 150 psig, for temperature control from 30 to 325 F. Adjustment range is 60 deg. The instrument has built-in strainers to protect pilot and main valve, stainless steel seats and discs, and internal porting. Eight-ft of capillary tubing and a 1 in. NPT connection on bulb are standard. Farris Stacon Corp.

20 — SPARE PARTS KITS

Contain complete sets of normal wearing parts for motor starters

To ease the problem of stocking spare parts for company's Life-Linestarters, these kits contain replacement moving contacts, moving contact springs, and stationary contacts. Six different kits cover 2- and 3-pole starters in sizes N0, N1, and N2. Two 2-pole kits can be used for 4-pole starters and one 2-pole and one 3-pole kit for 5-pole starters. Westinghouse Electric Corp.

21 — LAMP ANNUNCIATOR

Illuminated message type, for power plant applications

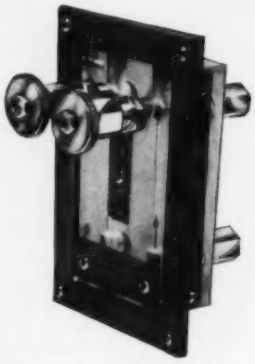
This new version of company's Type MLBR Annunciator has plug-in type relays used throughout. These annunciators can be of any capacity from one section up. Mounted behind each section, and a part of it, is the plug-in relay for that particular section. Voltages are up to 250, a-c or d-c. Each section is 3¾ in. wide, 1½ in. high. Up to three S6 bulbs can be used in each section box. Lamps are serviced from the front.

An abnormal contact condition causes the horn audible signal to sound and lights the message in two colors (red and white, i.e. pink). When the operator silences the audible signal the message is lighted in red. It stays red until contacts restore to normal, which automatically causes a different audible signal (bell) to sound and the message to be lighted in white. Operation of a toggle switch turns off the sound and lighted message. Cut-off of audible signal for one section does not prevent audible signal from sounding again in the event of an abnormal condition in another section. The H. R. Kirkland Co.

22 — PURGE METER

Multiple tube type, is built as a single integral unit

The Brooks-Mite Multi-Flow Purge Meter comes in two-, four-, or six-tube units. This plastic rotameter replaces



a similar number of single tube meters or bubblers for metering and regulating small flows of liquids or gases. All of the metering tubes and piping connections are bored in a block of acrylic plastic. The meter is available with a common manifold inlet for all metering tubes, or individual inlets. Rate-of-flow adjustment is made with separate needle control valves for each tube. A standard bezel is obtainable for flush panel mounting of any of these meters. Brooks Rotameter Co.

23 — POWER LINE FAN

Heavy-duty direct-drive type, for use against static pressure

These fans are suggested for industrial applications, exhaust systems and filtering units where large volumes of air are needed under static pressure. They are equipped with non-overloading cast aluminum airfoil type propellers and their motors are totally enclosed, ball bearing.

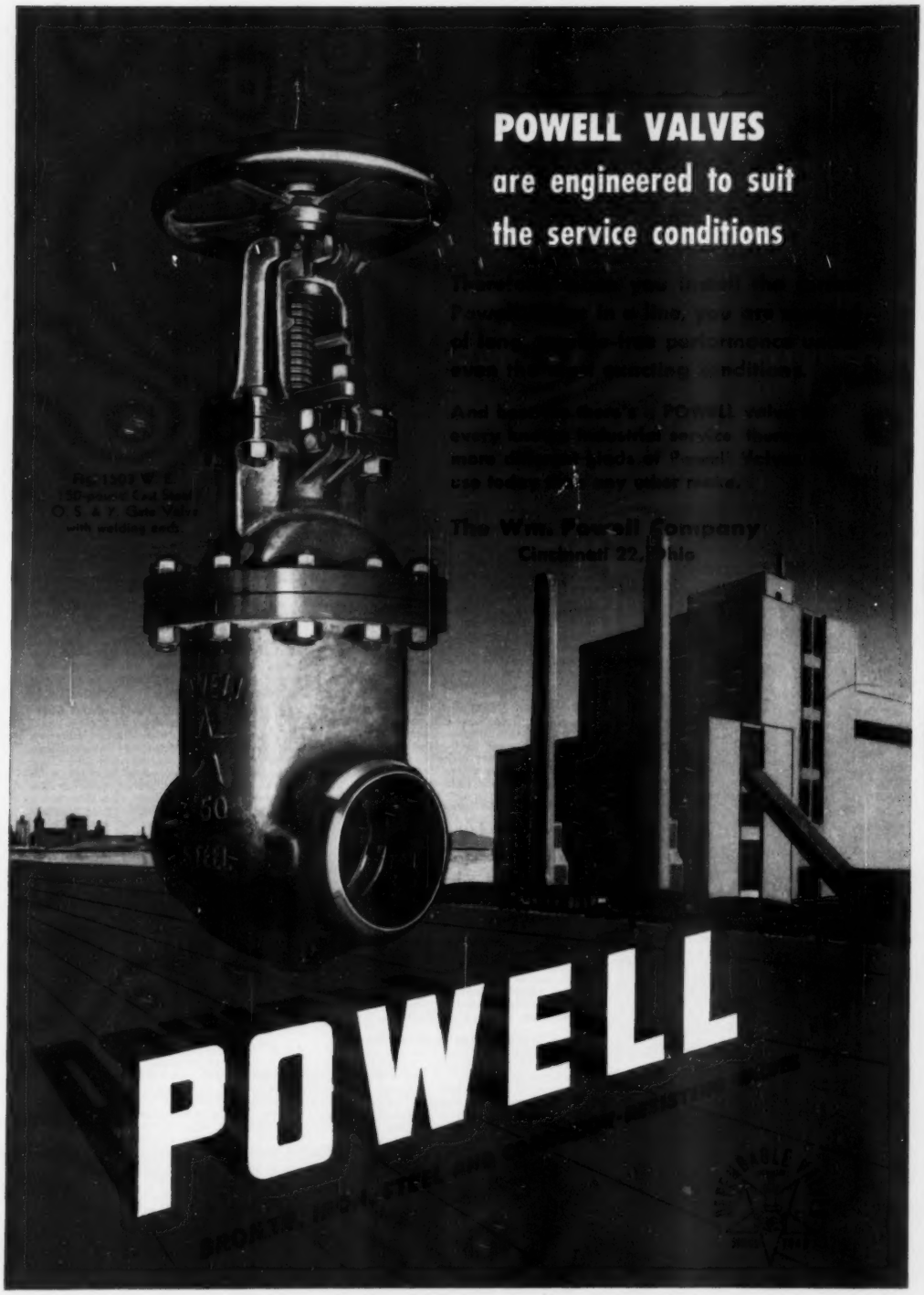
The fans are available in sizes from 16 to 48 in. and air deliveries from 2900 to 37,000 cfm. According to manufacturer, these fans are more economical than centrifugal type fans for similar applications. Chelsea Fan & Blower Co.

24 — PUTTY REMOVER

Streamlines job of getting putty out of broken windows

When used with an electric drill, the Master Putty Remover can remove in 2 min as much hardened putty from a window as can be removed in 30 min by hand methods, manufacturer announces, and it leaves the sash smooth and clean.

This inexpensive little tool can be used from either inside or outside of window after broken and cracked glass has been taken out. For use outside the


POWELL VALVES
are engineered to suit
the service conditions
POWELL

window a guide screw is attached, which rides on the top of the sash and keeps the operator from cutting too deeply. It is pointed out, however, that an experienced operator may remove putty from the outside of the window without first removing the glass, and in this case the guide screw isn't used. To avoid possible injury by flying glass particles it is recommended that operator wear goggles when using the Master Putty Remover. It is regularly priced at $3.50. H. E. Watkins Co.

25 — FILTER BAG CLOTH

Of silicon-impregnated glass, for high temperature use

Outstanding economies in bag house operations where high temperature dust control systems are required are reported through the use of filter bags made from Maco fabric, a silicon-impregnated glass cloth described as having a temperature range up to 550 F. The cloth was developed as part of a research program conducted in Los Angeles County, Cal., in an effort to control smog.

Tests of this fabric are reported to show 90 per cent effectiveness in the filtration of gases having in excess of 40 per cent submicron particulate. The discovery of Maco is credited with practically doubling the heat range that can be handled by bag filters. Maintenance of the baghouse operation is also said to be simplified because the smooth silk-textured Maco fabric can be cleaned with less shaking. Menardi and Co.

26 — CONTROL CENTER

For use with two or more a-c motors (up to 200 hp, 600 v)

Pre-engineered, wired and assembled and employing many standard components and accessories, this new center was developed for use in power stations, public buildings, paper mills, chemical and food processing plants. According to company engineers, it provides a simplified method of installing and servicing in central location a-c combination motor starters in NEMA sizes 1 through 5, as well as lighting panels and other equipment for a group of motors.

The center is designed to withstand short circuit stresses to 25,000 amp. Its sections (20 in. deep, 20 in. wide and 90 in. high) join to form a strong, free standing, dead-front NEMA 1 enclosed assembly. A main feature announced is a 4-in. vertical trough (with cable supports) which runs the full length of each section to provide ample space for wiring. All components, including pilot devices, are mounted on the lightweight unit frame. General Electric Co.

27 — INSTRUMENT WINDER

For easy winding of spring driven meters, controls

Since the invention of grandfather clocks no practical improvement has been made in key winders until now, says the manufacturer of the Winder-Upper. With this gadget the key becomes a crank. It's made in three types — the simplest, Type A, consists of a key end and crank. Type B includes a torque chuck with a slip-grip arrangement for converting the crank into a combination torque wrench and crank so the instrument won't be overwound. Type C is the same as Type B but is a brace design to prevent wobble. All types are chrome plated. J. A. Campbell Co.

Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the postage-paid card on pages 37 and 38 for your request

WATER CONDITIONING

201 Water Conditioning Information — Here are three informational bulletins. No. 28X744¢ describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system telling results to be expected. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

202 Modern pH and Chlorine Control — This 100-pp booklet gives details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

203 Water Softening Equipment — How problems caused by hard water can be offset by water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. The Permutit Co.

204 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

205 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Wright Chemical Corp.

206 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment and includes reference bibliography of literature on specific formulations. Dearborn Chemical Co.

207 Boiler Corrosion — A 12-pp article discussing cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111. The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity, physical factors are evaluated. W. H. & L. D. Betz.

208 Chemical Treatment of Water — Bulletins describing various methods of chemical water treatment, including company's Coravol process, are available. Coravol is part of a complete technical service which provides special chemical formulas for boiler feed water, foam prevention, hot water supply, refrigerating brine, cooling and condenser water. Western Chemical Co.

209 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Cochrane Corp.

210 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system. Worthington Pump and Machinery Corp.

211 What's New on Ion Exchangers — Here are three booklets covering company's ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp. Super Nalcolite. State those wanted. National Aluminate Corp.

FUEL OILS, LUBRICANTS

213 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and correction of these conditions by company's treatment. E. F. Drew & Co., Inc.

214 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

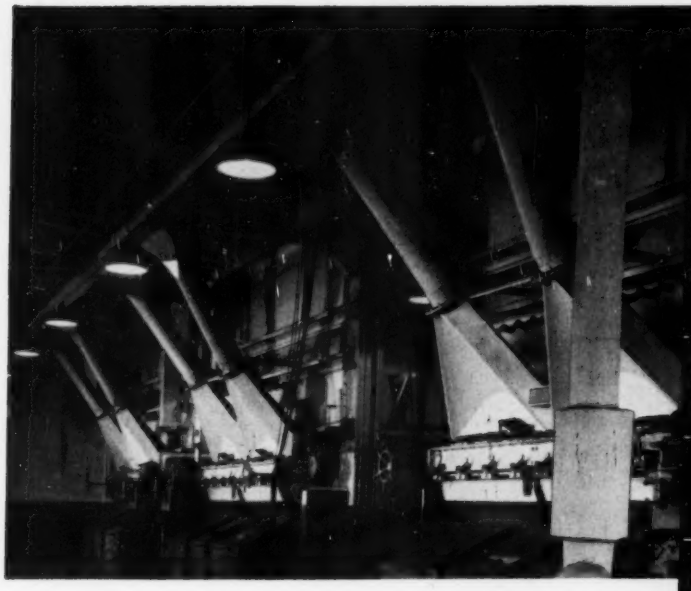
215 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, also lubricating systems, and diesel oil purification and filtration. Includes discussion of fuel and lubricating. Sinclair Refining Co.

216 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. A series of torsion viscometers shows how viscosity acts and may be measured. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI gives brief reference to nature of plastic flow. The Texas Co.

217 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. Also discusses purification of fuel oil for diesel engines. The DeLaval Separator Co.

218 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil, and the question of system efficiency, as affected by circulation rate and system. Bowser, Inc.

(Continued on page 118)



do your boilers need?

? ADJUSTMENT OF PRE-TREATMENT

? ADJUSTMENT OF INTERNAL TREATMENT

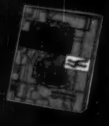
? PROPER MEANS FOR TREATMENT APPLICATION

? BLOWDOWN ADJUSTMENT

? TEST CONTROL

then CALL YOUR DEARBORN ENGINEER OR WRITE FOR THIS VALUABLE BOOKLET.

Bulletin 5000 describing Dearborn's Industrial Water Treatment and Engineering Service will be sent on request



65 years of water treatment experience available to you

Since 1887, Dearborn has strived to make the problem of providing trouble-free water for users of steam as simple and economical as possible.

Today, Dearborn has every facility—plus a broad background of experience—to help every business, every plant reduce the cost of maintaining its boiler room or power plant operation.

Dearborn Sales Engineers—thoroughly trained to analyze your plant and evaluate your needs—are available to you for consultation, without obligation.

DEARBORN CHEMICAL COMPANY

Merchandise Mart Plaza • Chicago 54, Illinois

Dearborn Chemical Company, Dept. PG
Merchandise Mart Plaza, Chicago 54, Ill.

☐ Please send Bulletins 5000

☐ Have a Dearborn Sales Engineer call

Name.....

Position.....

Company.....

Address.....

City.....*State*.....

Dearborn

TRADE MARK REGISTERED

THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT *Construction News*

Troy, Ala. — California Spray Chemical Corp., Lucas St., Richmond, Calif., oil sprays, insecticides, etc., plans boiler house at proposed new branch plant at Troy where site has been acquired, to be used for production of insecticides. No official estimate of cost announced — reported over $200,000. Proposed to begin work at early date.

San Diego, Calif. — San Diego Gas & Electric Co., 861 6th Ave., is arranging fund of about $18,600,000 for expansion and improvements in plants and system in 1952. Program will include completion of expansion at local Silver Gate steam-electric generating station, with installation of new 50,000-kw. turbine-generator unit and accessories.

San Francisco, Calif. — Pacific Gas & Electric Co., 245 Market St., has arranged budget of about $132,000,000 for expansion and impovements in power plants, power substation, transmission lines and other electrical facilities in 1952. A considerable part of fund will be used for increased generating capacity.

Van Nuys, Calif. — Lockheed Aircraft Corp., Burbank, Calif., airplanes and parts, plans new boiler house at plant at 6821 Clybourn Ave., Van Nuys, about 33 x 60 ft. Cost reported close to $100,000, with boilers and auxiliary equipment.

Colorado Springs, Colo. — Department of Public Utilities, 18 South Nevada Ave., has approved plans for new municipal power plant, to be four-story and basement, with mezzanine floor, 122 x 160 ft. Installation will include turbine-generator, high-pressure boiler and auxiliary equipment. No official estimate of cost announced. Work on superstructure will begin soon. Lutz & May, Finance Bldg., Kansas City, Mo., are consulting engineers.

Wilmington, Del. — Hercules Powder Co., Delaware Trust Bldg., Chemical Division, is reported planning boiler house at proposed new plant on Delaware River water front for production of phenol, acetone and other chemicals. It will comprise a number of units and is reported to cost close to $7,000,000. It is understood that work will proceed early in spring.

Boise, Idaho — Idaho Power Co., Boise, has plans maturing for proposed new hydro-electric generating station on Snake River at point on Oregon-Idaho border. Project will consist of power dam, water reservoir and power house, with hydraulic-turbines and electric-generators with rating of 140,000-kw. Construction will begin as soon as license is received from Federal Power Commission, Washington, D. C. This will be the first of five hydroelectric installations in immediate vicinity, known as Oxbow project.

Priest River — Seattle District, Corps of Engineers, U. S. Army, 4735 East Marginal Way, Seattle, Wash., has plans maturing for new hydroelectric generating station on Pend Oreille River, Bonner County, near Priest River. Contract will be let soon for construction of power dam, with work on power house to follow at later date. Installation will include 3 hydraulic turbines and electric generators. No official estimate of cost announced — will represent large investment.

Chicago, Ill. — Acme Resin Corp., 1401 Circle Ave., Forest Park, Ill., plastic molding products, will build boiler plant at new factory at 7100-10 West 60th St., Chicago. Entire project reported to cost close to $250,000. Work will proceed at once.

South Bend, Ind. — Indiana & Michigan Electric Co., South Bend, plans expenditure of close to $57,000,000 during 1952–53 for expansion and improvements in generating plants, power substations, transmission lines and other operating facilities. Of this amount approximately $27,000,000 will be used this year. Entire program includes installation of three new generating units, totaling 500,000-kw. in all, at Tanners Creek power plant.

Humboldt, Iowa — Corn Belt Power Cooperative, Inc., Humboldt, has plans maturing for new steam-electric power plant on site near Humboldt. Installation will include a 15,000-kw. turbine-generator unit, boilers and auxiliary equipment. Proposed to begin work at early date. Stanley Engineering Co., Hershey Bldg., Muscatine, Iowa, is consulting engineer.

El Dorado, Kan. — El Dorado Refining Co., plans extensions in power house at local oil refinery, in connection with a general expansion program at plant, with installation of equipment for increased capacity. Entire project is estimated to cost about $3,300,000. Proposed to begin work soon.

Grafton, Mass. — Dept. of Mental Health, Commonwealth of Massachusetts, 15 Ashburton Pl., Boston, Mass., plans extensions and improvements in power house at State Hospital at Grafton, including installation of new steam turbine unit and auxiliary equipment. Appropriation has been authorized. Work is expected to begin soon.

Niles, Mich. — Kawneer Co., North Front St., Niles, store fronts, doors, etc., plans boiler house at proposed new plant on site near city, to be used for production of aircraft parts for Government at present time, and later for company products. It will approximate 100,000 sq. ft. floor space, and will cost about $1,000,000. Work will proceed at once.

Indianola, Miss. — Ludlow Mfg. & Sales Co., Ludlow, Mass., jute yarns and twines, and other cordage, plans boiler house at proposed new mill at Indianola, where site has been acquired. Mill will comprise several units. Entire project is reported to cost about $700,000. Proposed to begin work at early date. Mill will be owned by municipality and occupied by company under long-term lease.

New York, N. Y. — Consolidated Edison Co., 4 Irving Pl., will continue expansion of East River generating plant, 14th St. and East River, during 1952, with installation of new 160,000-kw. turbine-generator unit and auxiliary equipment, scheduled for completion in 1953. This follows installation of two 125,000-kw. units, recently completed. Company is reported to have arranged budget of close to $85,000,000 for expansion and improvement in electric power facilities in 1952.

Roanoke Rapids, N. C. — Virginia Electric & Power Co., Franklin and Seventh Sts., Richmond, Va., has plans maturing for proposed new hydroelectric generating station on Roanoke River, vicinity of Roanoke Rapids, and will begin work at early date. It will be equipped for a capacity of 90,000-kw., and is scheduled for completion in 1955. Cost estimated about $27,-500,000, with power substations, transmission lines and other operating facilities.

New Philadelphia, Ohio — Warner & Swasey Co., 5701 Carnegie Ave., Cleveland, Ohio, machine tools and parts, is reported planning boiler house at proposed new plant at New Philadelphia, for production of machine tool parts. It will be one-story, approximating 110,000 sq. ft. floor space, and is reported to cost about $1,500,000. Proposed to begin work soon.

Ponca City, Okla. — Continental Oil Co., Ponca City, plans extensions in power house at local refining plant, with installation of new steam turbine and accessories, high-pressure boilers and auxiliary equipment. Work will be carried out in connection with a general expansion and development program at refinery, entire project to cost about $7,500,000. Main offices are in Sterling Bldg., Houston, Tex.

Johnstown, Pa. — Pennsylvania Electric Co., Johnstown, is arranging fund of approximately $26,000,000 for expansion and improvements in plants and system during 1952, including generating facilities, power substations, transmission and distributing lines. A considerable part of appropriation will be used for work on new generating station at Shawville, Pa., now in course of construction, and scheduled for completion in 1953. This plant will represent a total reported investment of $38,000,000.

York, Pa. — Standard Register Co., 626 Albany St., Dayton, Ohio, business forms, plans boiler house at proposed new plant at York, where site has been selected. New factory will approximate 64,000 sq. ft. floor space, and is reported to cost in excess of $350,000. Work is scheduled to begin soon.

Dallas, Texas — Dallas Power & Light Co., 1506 Commerce St., has plans in progress for new generating station, to be known as Parkdale plant, with initial capacity of 80,000-kw. Program is scheduled for completion late in 1953.

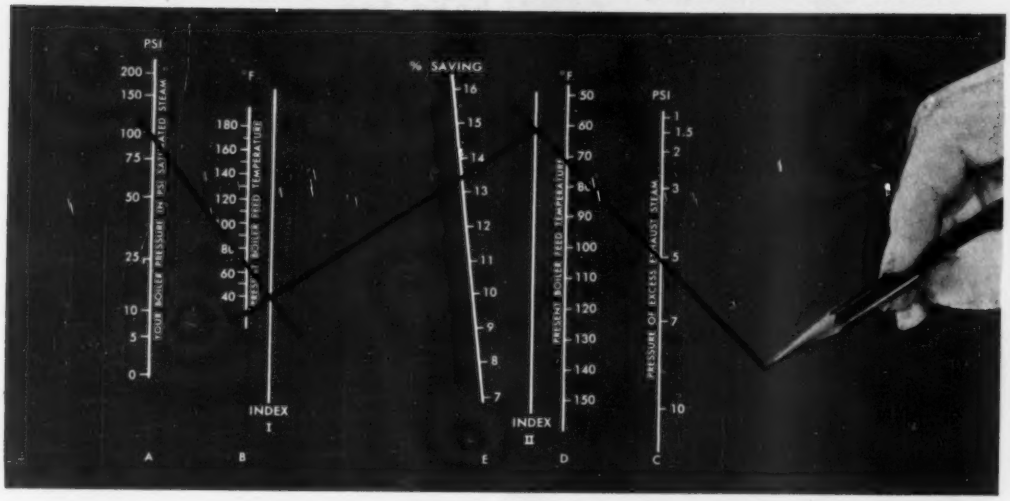
Dallas, Texas — Texas Power & Light Co., Interurban Bldg., will carry out expansion in new Lake Creek steam-electric generating plant during next 24 mos., with installation of an 80,000-kw. turbine-generator unit, high-pressure boilers and auxiliary equipment. Preliminary plans are in progress for another new generating station in 1954, with initial capacity of 100,000-kw.

Fort Worth, Texas — Texas Electric Service Co., 7th and Lama Sts., plans expansion in Morgan Creek steam-electric generating plant during 1952, with installation of a new 44,000-kw. turbine-generator unit and auxiliary equipment. During 1953 extensions will be made at Fort Worth plant to increase capacity about 80,000-kw., while a new generating plant is planned in 1954, with initial capacity of 100,000-kw.

Orange, Tex. — Solvay Process Division, Allied Chemical & Dye Corp., 61 Broadway, New York, N. Y., chlorine, caustic soda, and kindred industrial chemicals, plans steam-generating station at proposed new plant near Orange where tract of about 650 acres of land has been selected. It will be used for production of organic chemicals and is reported to cost approximately $5,000,000. Work is scheduled to begin next spring, with completion late in 1953.

Moundsville, W. Va. — Solvay Process Division, Allied Chemical & Dye Corp., 61 Broadway, New York, N. Y., Chlorine, caustic soda, etc., plans steam-generating station at new plant at Moundsville, where tract of about 400 acres of land has been secured. It will consist of several large units for production of chlorine and caustic soda. Electric power facilities will be secured from Appalachian Electric Power Co., with power substation to be located at plant site. Entire project will represent a reported investment of $15,000,000. Work will begin soon and is scheduled for completion late in 1953.

Use exhaust steam and cut fuel costs with a Swartwout Feed Water Heater

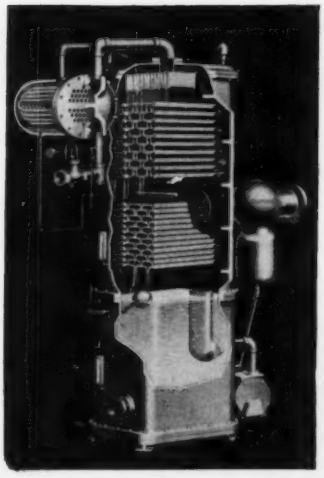


1 **UTILIZING RESIDUAL HEAT** in exhaust steam, you effect a direct saving in fuel costs of approximately 1% for each 11°F increase in boiler feed water temperature. Furthermore, you improve boiler operation in other important, cost-cutting ways. Faster steaming rate . . . removal of the soluble gases that cause costly corrosion in boiler and economizer . . . reduction of temperature strains.

Here's how to figure your fuel savings. Connect point on A to point on B; project line to intersect Index I. Connect points on C and D; project line to intersect Index II. Connect points on I and II and read your fuel savings on Scale E. The example given (100 psi saturated steam boiler using 70°F feed water and 5 psi exhaust steam) shows a *saving of approximately 13.6% of your present fuel cost.* A-8063

Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION

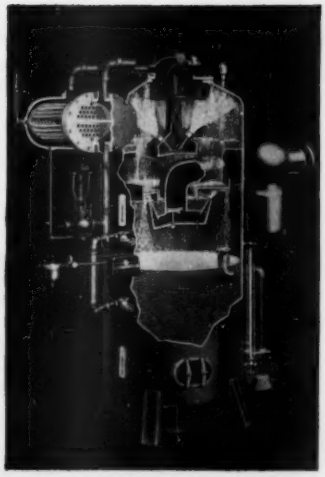


2

SWARTWOUT TRAY TYPE HEATERS, by using counterflow principle, give greatest degree of deaeration because water is in contact with clean steam just before dropping into storage section. Swartwout cast iron or steel deaerating heaters (.03 oxygen guarantee) and deaerators (.005 oxygen guarantee) can be supplied with cast iron or stainless steel trays.

3

SWARTWOUT SPRAY TYPE (atomizing) deaerators are of all-steel construction, give feed water with oxygen content guaranteed not to exceed .005 cc per liter of water. All surfaces which are subjected to impingement of water are made of corrosion-resistant stainless steel. Swartwout feed water heaters are specially designed to meet your individual requirements and range from 5000 to 300,000 lb. capacities.



SEND FOR BULLETINS S-18-E, S-210 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

ONLY COCHRANE ZEOLITE SOFTENERS and FILTERS have the HYDROMATIC SINGLE CONTROL VALVE

Below is shown a Hydromatic Valve arranged for automatic operation.

ONE important feature of Cochrane Zeolite Softeners and Filters is the Hydromatic Single Control Valve replacing the usual "valve nest" or rotary disc single control valves of other equipment. It has the following advantages:

1. It is pilot-operated . . . easy to operate.
2. Soft, single-seated individual valves insure drop-tightness.
3. Six positions—four normal, one shut-off, one for draining.
4. Individual valves easily accessible and replaceable.
5. Automatic and adjustable backwash and rinse controls eliminate need for concrete sumps.

Exploded view of Hydromatic Valve with Front Distributor detached showing detail of valve.

Write for a copy of this 32-page publication (No. 4520) describing not only the Cochrane Hydromatic Single Control Valve, but also, in complete detail, a description of the Cochrane Sodium Zeolite Softener. A separate publication (No. 4530) describes Cochrane Hydrogen Zeolite Softeners. Mention which type you are interested in.

COCHRANE CORPORATION
3123 N. 17th Street, Philadelphia 32, Pa.

In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico: S. A. Mexico City
In Europe: Recuperation Thermique & Epuration: Paris

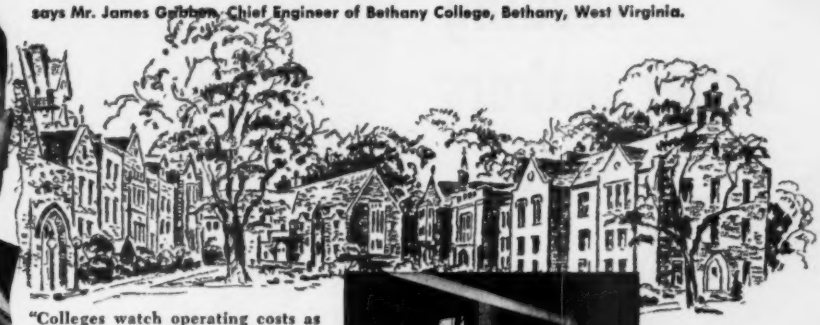
COCHRANE

PIONEERS AND LEADERS IN BOILER FEED PROCESS & INDUSTRIAL WATER CONDITIONING
COCHRANE CORPORATION
89
YEARS OF SERVICE
1863 - 1952

"We 'educated' our College Heating Plant...

with a modern coal installation we saved more than a third of our fuel bill,"

says Mr. James Gebben, Chief Engineer of Bethany College, Bethany, West Virginia.



"Colleges watch operating costs as closely as any business firm—and one big item for our college is the heating bill. That's exactly why Bethany went to the expense of putting in new coal heating equipment! Our old system supplied heat for sixteen buildings—to the tune of 2,600 tons of coal a year. Our new installation, with its automatic stoker, does the same job using only 1,650 tons. That's a fuel saving of 38.9%! Our eyes certainly have been opened to the efficiency and economy of *bituminous* coal—especially when it's burned with modern equipment."

Here's Bethany's new boiler room, showing the pipe of the automatic stoker. **THIS MODERN EQUIPMENT WILL PAY FOR ITSELF, THROUGH FUEL SAVINGS ALONE, IN LESS THAN TWO YEARS!**

Modern combustion installations can add anywhere from 10% to 40% to the energy obtained from the same amount of coal in years gone by. Great advances have been made in coal- and ash-handling equipment, too—cutting labor costs—making coal as clean and convenient to use as any fuel.

If you're planning to modernize your present installation—or thinking of building a new plant, call in a competent consulting engineer. He'll show you how a modern coal system designed to meet your specific needs can save you money and serve you better!

And don't forget—you'll always be able to get the coal you need. America's coal industry is the most efficient in the world. America's coal reserves are ample for centuries to come. Right now and for the future, too, coal users can be assured of a dependable fuel supply at reasonable prices.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Washington, D. C.

If you're running your own steam plant—for heat or for power—you just can't afford to ignore these facts!

COAL in most places is today's most economical fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

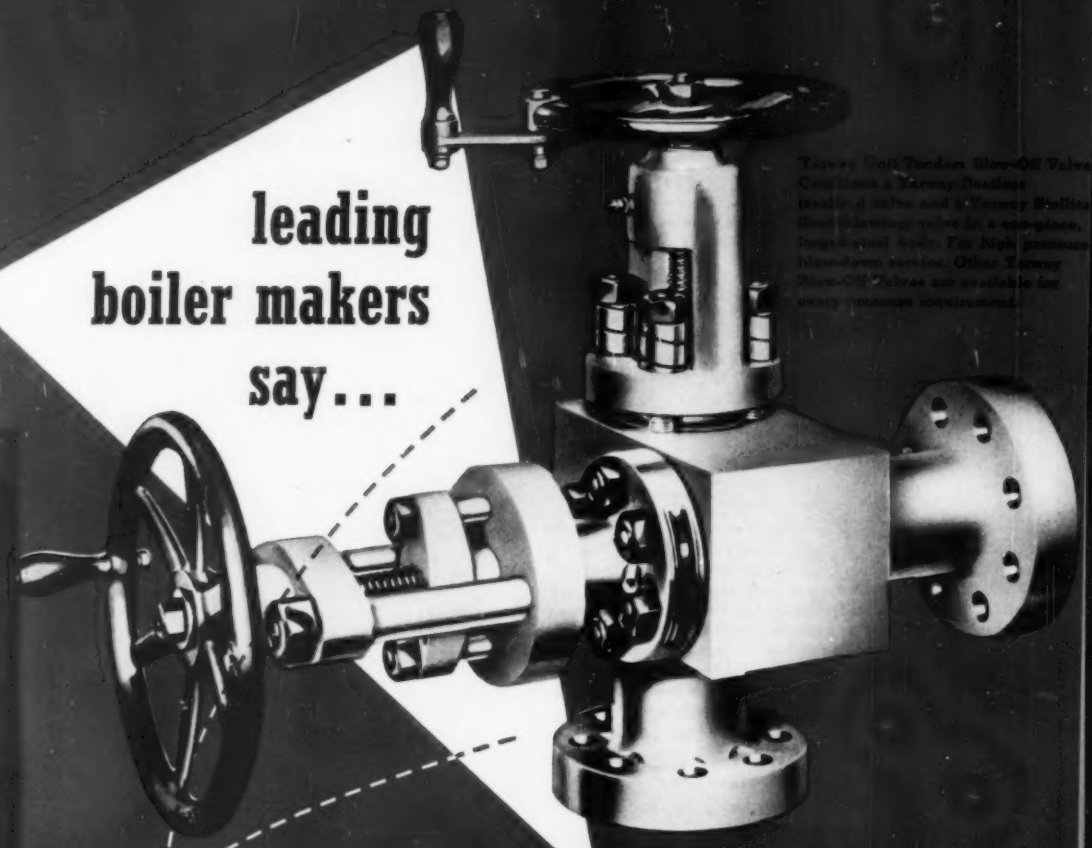
COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY — FOR LOW COST

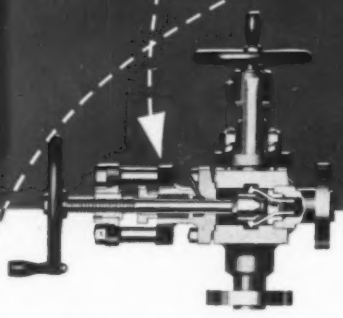
YOU CAN COUNT ON COAL!

leading boiler makers say...

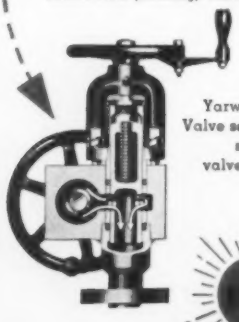


YARWAY

BLOW-OFF VALVES



Yarway Unit Tandem Valve sectioned through stellite-seat (blowing) valve. Open position.



Yarway Unit Tandem Valve sectioned through seatless (sealing) valve. Open position.

Leading steam boiler makers (names on request) standardize on Yarway Blow-Off Valves . . . for the same reasons that over 15,000 plants use them:

- UNIQUE DESIGN
- MODERN METALLURGY
- RUGGED CONSTRUCTION

} TROUBLE-FREE SERVICE

How these features will help your boiler operation is clearly explained in Yarway Blow-Off Valve Bulletins. Write for one, telling us your operating pressures.

YARNALL-WARING COMPANY 114 Mermaid Ave., Philadelphia 18, P
Branch Offices in Principal Cities

STOP BLOW-DOWN TROUBLES...KEEP BOILERS ON THE GO

LETTERS TO THE EDITORS

CHRISTMAS—AND FINE PERFORMANCE!

THANKS for the Christmas booklet of cartoons. They were all good and the boys got a big kick out of them. When you said that you would be thinking of me sitting on a nice warm beach this Christmas with a glass of Ron Rico, you were not far from wrong, for our department had its Christmas party down on the beach Friday afternoon and evening, the 21st of December, with plenty of old Ron Rico and Don-Q.

Well, we will get the new diesel engines, which makes me happy. They will be two more like the ones we now have, making the plant still 100 per cent the same make of diesels.

On January 3 this year, this plant celebrated its 10th year of continual operation, and in that 10 years we have only had a total outage time of 60 min. and not one minute of this time was due to mechanical failure of any of the power plant equipment. Of this outage time, 75 per cent was due to man failure, because at no time in the life of the plant have we ever had one experienced power plant man. From the chief engineer down, all have been made from green material, and when I say green I mean green, as only about half of them could speak English and some could not read or write in any language. (Yes, my hair is gray now, but I am thankful I still have some.) So you see that accounts for the high per cent of man failures.

But all in all the plant has managed to keep a fair average efficiency of 12.45 kwh per gal of fuel, with an operating capacity factor of about 65 per cent. Fuel oil is rather high but we stay under one cent per kwh most every month.

W.O.T.

P.S. The envelope is just to tantalize you. — W.O.T.

Editor's Note:—And it did! The envelope showed very seductive pictures of Southern beaches, palm trees, orange trees, golf courses and—m-m-m—sailing boats. Boy! Two tickets to Elysium, quick!

HEADERS

DURING THE PAST year I have read articles in various technical publications in which there were two boilers to each turbine. In some of these articles it was mentioned that headers were installed. However, the information concerning the piping was either scanty or lacking entirely.

Now in a modern high-pressure, high-temperature plant, piping is one of the most important features, and, furthermore, many engineers devote their entire efforts to pipe designing. Therefore, in describing a steam power plant, I wish to suggest that the following data be included, either by description or by a single-line piping diagram:

1. Where there are two or more boilers per unit, but the units are not cross-connected, the piping layout between the superheater outlets and the turbine throttle valve should be shown.

2. If headers are installed, it should be shown whether one or two continuous headers are installed, with all boilers feeding into and all turbines taking steam from common headers, or whether unit headers are installed, with or without cross-connections between the unit headers.

HOWARD T. LIVINGSTON
Los Angeles, Calif.

STARTING UP

IN THE December issue, A. B. Fortman called attention to the apparent need for spreading around more of the available information on how to get and use clean condensate or distilled water for flushing and filling the first boiler on a new power station. Reason for this is to prevent carry-over into the turbine right at the beginning. Mr. Fortman reported that, despite considerable information available on this subject, he recently heard of a station that did not use sufficient care in providing start-up water and had silica carry-over on a brand new unit. He suggested further data from readers would be useful.

Here's How They Did It in Belgium

PROBLEM of getting enough perfectly clean condensed or distilled water for the initial flushing-out of the boilers in a new generating station occurs only, as a rule, with the first boiler. For the subsequent ones there usually is no problem, since at least one turbine will be in operation by then and the evaporators will certainly have enough capacity. A few months ago we started a 100-mw steam electric power station having four 130 ton per hr boilers,* 1000 psi, 932 F. Here is how we did it!

Our make-up water treating plant has a capacity of 15 ton per hr. It operates along the conventional lines as follows: lime-soda cold process, sodium zeolite end softening, and evaporation.

At the time we had to start the first boiler, all this plant was ready for operation except, of course, the evaporators, which were waiting for the turbine, which was waiting for the boiler.

Accordingly, we installed a small additional deionizing plant capable of 1 cu m per hour (35.3 cu ft or about 2200 lb per hr). That gave us water that approached very near the purity of distilled water. The small capacity was no trouble since we had plenty of time ahead to prepare the necessary quantity of water.

Before starting up the boiler, we had it flushed several times with ordinary river water; then several times again with clear softened water. After each flushing, the drums and headers were cleaned by hand and hand lancing.

When we were satisfied that the boiler was as clean as we could get it by this method, we filled it with clean anion-cation-treated water, and a given amount of chemicals. Two or three oil burners were lighted up and the boiler was brought up to a reduced pressure, just sufficient to insure water circulation between high and low drums (about 70 to 100 psi). This soaking went on for 24 hr, with periodic blow-downs.

This procedure was repeated two or three times before actually producing steam — and you would be surprised to see what comes out of the boiler.

Liege, Belgium P. VAN HERK

* Mr. Van Herk does not specify whether tons per hour are long tons or not. We suspect they are, for the long or 2240-lb ton is often used in Europe. If so, capacity would be about 286,000 lb per hr. If it is short tons or 2000-lb tons, it would be 260,000 lb per hr. However, if it is metric tons, also common in Europe, then 1 cu m = 1 metric ton = 1.1023 short tons = 2204.6 lb.

BOUQUETS

I TAKE a great interest in your *Practical Engineer and Electrician* section, because you bring up some highly interesting angles in power plant work . . . I want to take this opportunity to compliment you on the intelligent way you handle this department in your very excellent magazine. I, for one, get great enjoyment in studying the items in this department.

St. Louis, Mo. A.F.R.

Editor's Note:—Thanks for those kind words. Everything we bring up in the *Practical Engineer* is directed toward the everyday problems of power plant operating men. These data come to us from readers and from our own personal visits to all types of power plants, where we are always looking for this type of information. It isn't easy to get either, for many engineers cannot write it for us, but put it up to us to "write up" things they show us.

MORE POWER to your Q & A department. I turn to it first of all as soon as the magazine comes in.

New York L.C.V.H.

I THINK your November issue is the most interesting one in a long time because it contains so much down-to-earth information on power plant equipment, how to buy coal and other practical details. Give with more of that kind of stuff, brother!

Michigan J.E.G.

Editor's Note:—We'll certainly do our best, J.E.G., to give with all we can get of that kind of stuff.

Fig. 1. A recent view of the E. M. Poston Generating Station

E. M. Poston Generating Station of

First two 40,000-kw units now in operation. . . . A third unit of 60,000 kw capacity now being installed will go into service sometime in the fall of this year. . . . This equipment together with a fourth unit which will be installed in 1953 will give this outstanding new power station a capacity of 200,000 kw

THE E. M. POSTON GENERATING STATION of the Columbus and Southern Ohio Electric Co. is located in southern Ohio about 5 miles northwest of Athens. This newest of the four generating stations on the system was formally dedicated on June 20 of last year but trial operation on the first 40,000-kw unit was started on October 22, 1949. A second 40,000-kw unit went into operation in October 1950, and a third unit, a 60,000-kw unit now under construction, is scheduled to go into service during the fall of 1952. Thus, by the end of this year, the station will have an installed capacity of 140,000 kw.

Installation of another 60,000-kw machine is now in progress; this is scheduled for completion in late 1953. This will give the station an ultimate capacity of 200,000 kw. Total cost of the completed plant is expected to reach $36,000,000.

The Columbus and Southern Ohio Electric Co. system extends from the Ohio River in the south central part of Ohio to the area just north of Columbus. The area includes a smaller area served by the Ohio Midland Light and Power Co., which company, however, purchases all of its energy from the Columbus and Southern.

E. M. Poston

E. M. Poston, after whom the station is named, was a distinguished son of the Hocking Valley who devoted most of his lifetime to the development of the natural resources of the area in which he lived. As early as 1888, together with two associates, he secured a franchise for lighting the streets of Nelsonville and to engage in the commercial production of electricity. This was the beginning of the enterprise which, in later years, grew into Southern Ohio Power Co., which, when consolidated with the Columbus Railway, Power & Light Co. formed the Columbus and Southern Electric Co. Today, the E. M. Poston Generating Station stands as a monument among the hills and valleys he loved so well. Mr. Poston died in 1931.

Though modern in design and construction down to the last detail, the Poston Station is of special interest because of its fuel and water supplies. All water requirements, including those for condenser cooling, are supplied by shallow wells located near the Hocking River approximately 7000 ft northeast of the plant site. A 40-million gallon reservoir is located northwest of the plant to store well water for emergency use. The process for treating the water includes aeration, chlorination, lime-alum softening and acid treatment. Filtration and zeolite softening equipment are also provided ahead of the steam generator make-up evaporator. An elevated 50,000-gallon tank north of the plant stores treated water for reserve and fire protection. A 16-cell cooling tower supplies circulating water to the condensers.

With respect to the fuel supply, the station is built directly within extensive coal deposits but at the present

This description of the E. M. Poston Generating Station is of particular interest because of several somewhat unusual features. First, is the arrangement of the turbine room with its low roof and the gantry crane riding above it. The boilers are outdoors, not unusual these days, but together with the turbine room arrangement, provide a type of design that reduces building structure costs to a minimum. Next, is the location of the station on top of its future coal supply, and its present use of coal from mines three miles away. Though this coal is now delivered by truck, plans call for the installation of a conveyor three miles long which will carry the coal directly from the mines to the station. Finally, its entire water supply, including that for the condenser circulating water, is taken from shallow wells

time these company owned deposits are not used. Instead, coal is purchased from nearby mines and is trucked to the plant. At some future date deep mines will be opened on the Company property to supply the needs of the plant.

Present coal requirements are approximately 1000 tons a day. This is brought to the plant by trucks and delivered to a track hopper from which a conveyor carries it to the crusher tower. From this point the coal may be sent either to the main plant bunkers by belt conveyors, having a capacity of 300 tons per hr, or it may be delivered to the coal storage conveyor. A 150,000-ton storage area is provided to the west of the plant. Present storage is about 100,000 tons.

The use of trucks for transporting coal to the plant is a temporary expedient. Plans are now being prepared for the construction of a conveyor belt to transport the coal from the mines two or three miles away, to the storage yard.

General Design of the Station

As may be seen from the photograph in Fig. 3, the station is of the semi-outdoor type with the major parts of the three steam generators outside and the turbines and control equipment indoors. A novel feature of the turbine room design is its comparatively low ceiling, made possible by arranging the turbine room crane to travel above the turbine room roof rather than underneath it as is customary. With this arrangement, access to the machinery is had through hatches suitably located in the roof above the generating units. The crane is of the gantry type. This type of turbine room construction, together with the outdoor boiler arrangement eliminates a considerable amount of building cost.

In accordance with modern design, the E. M. Poston Station embodies the unit system, one boiler serving one turbine generator without interconnection. Thus, there are three boilers and three generating units. Boilers Nos. 1 and 2, each serving a 40,000 kw generating unit are Foster Wheeler dry hopper bottom units rated at 425,000 lb of steam per hour. These operate at 1350 psig, and 955 F. Boiler No. 3, now in process of being installed, and which will supply steam to a 60,000-kw generating unit, is a 625,000 lb per hour unit. The general design of the three boilers is the same except that the larger unit has a tubular air heater whereas the two smaller ones have regenerative type air heaters.

Each of the two smaller boilers is fired by six powdered coal burners

Columbus & So. Ohio Electric Co.

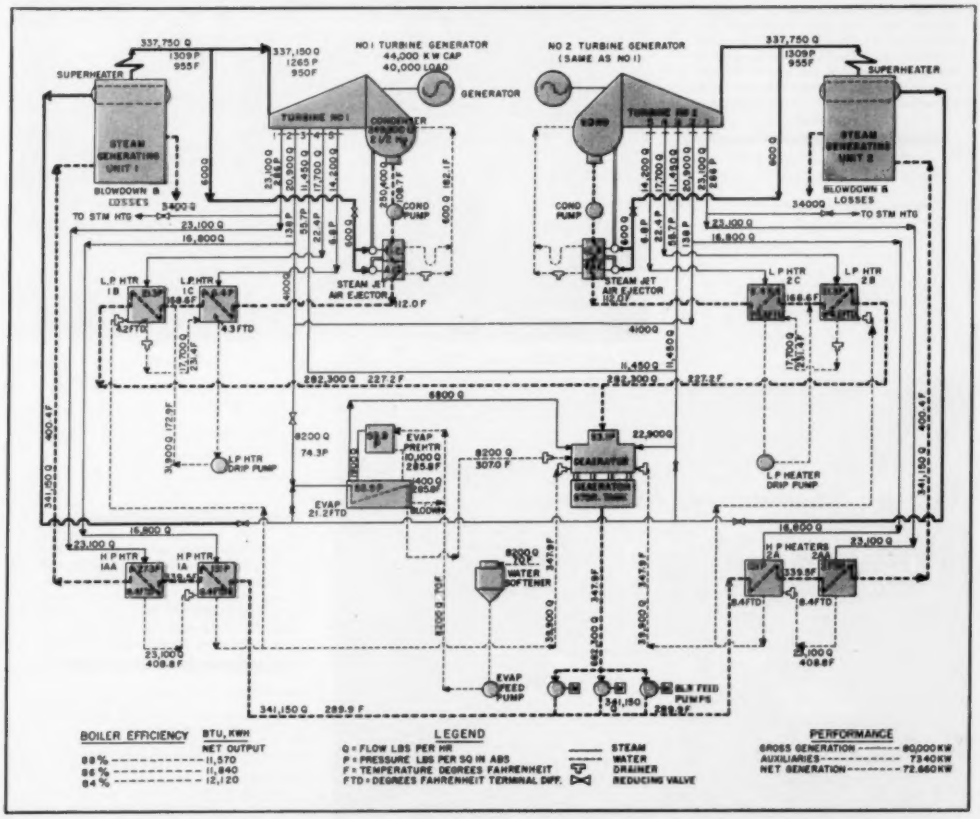


Fig. 2. This is the heat balance diagram for a station load of 80,000 kw with the two 40,000-kw units in operation

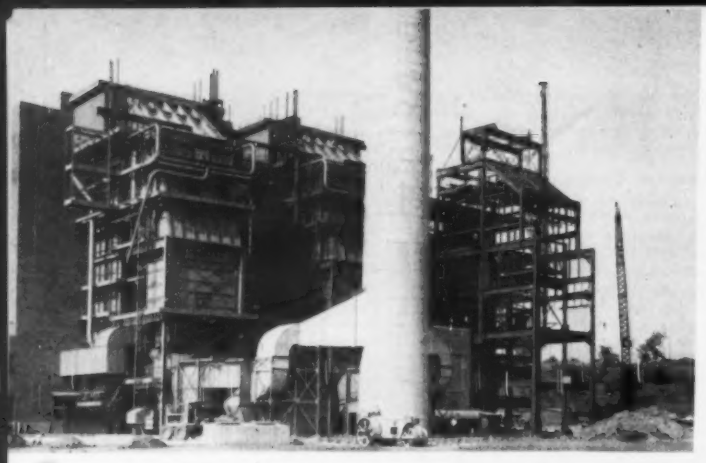


Fig. 3. An exterior view showing the first two boilers at the left and the third under construction at the right. Note the forced and induced draft fans, air heaters and dust collectors in foreground. This view also shows excavation for the foundation for the second stack at the extreme right

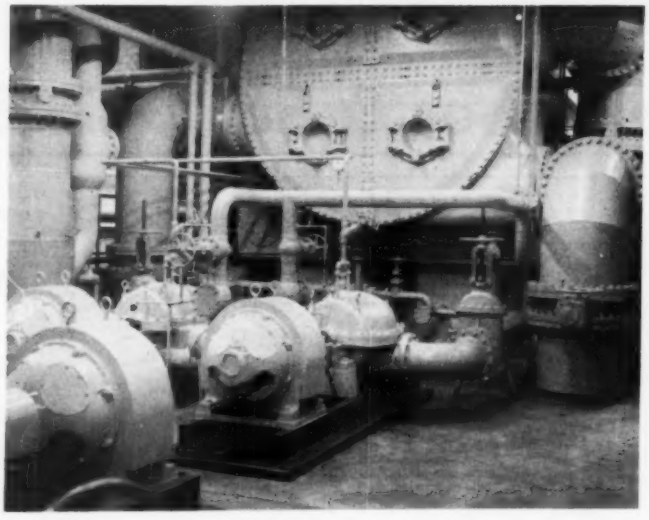


Fig. 4. A view on the condenser floor showing the condensate pumps in the foreground. Note that the condensers are installed close to the floor with all auxiliary machinery off to one end. The condensers themselves are set to one side of the turbine so that the overhead turbine room crane has easy access to all condenser equipment

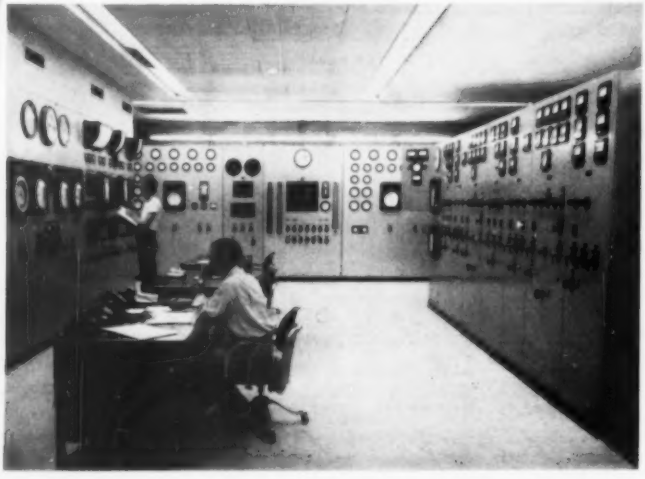


Fig. 5. Here is the central control room. It is entirely enclosed by windowless walls and the control of the entire station is from these panels. The boiler control panels are shown at the left. The electrical switchboard is at the right, and the turbine control panels are at both ends of the room

supplied from two ball type mills. The 625,000 lb unit will have three ball mills however. All boilers are equipped with economizer, air preheater, dust collector, and forced and induced draft fans. The forced and induced draft fans are located outdoors at ground level, as are also the air heaters and dust collectors. Each group of two boilers is served by one 200 ft high concrete stack. Under rated load, each of the two smaller boilers will burn approximately 550 tons of coal per day. Coal is relatively low in cost and the design of the whole station is based to a large extent upon low fuel cost. At 88 per cent boiler efficiency the heat rate at full load is 11,570 Btu per kwh.

The heat balance diagram for a load of 80,000 kilowatts involving only the two units now in operation, is shown in Fig. 2. The turbines have 5 extraction points. Two bleed points feed low pressure heaters, two, high pressure heaters, while the 5th supplies the evaporator. Condensate passes first through the inter- and after-coolers of the steam jet air ejectors, then through the two low pressure heaters and to the deaerator. From the deaerator storage tank the boiler feed pumps deliver the water through the two high pressure heaters to the boiler. A single deaerator serves two boilers. There are three boiler feed pumps for two boilers, each rated at 475,000 lb per hr at 3850 ft head and driven by 1500-hp constant speed motors.

Make-up water from the water softener is delivered by the evaporator feed pump through the evaporator preheater to the evaporator. Vapor from the evaporator passes directly to the deaerator.

An interesting feature of the equipment arrangement in the turbine room is the fact that no auxiliaries are located underneath the condensers.

In the case of the 40,000-kw units, the condensers are off to one side and parallel to the turbine foundation, while the 60,000-kw unit condenser is crosswise under the turbine. The condensate pumps are located on the ground level floor adjacent to the respective condensers.

The condenser water circulating pumps are located in a concrete pit near the cooling tower. There are four

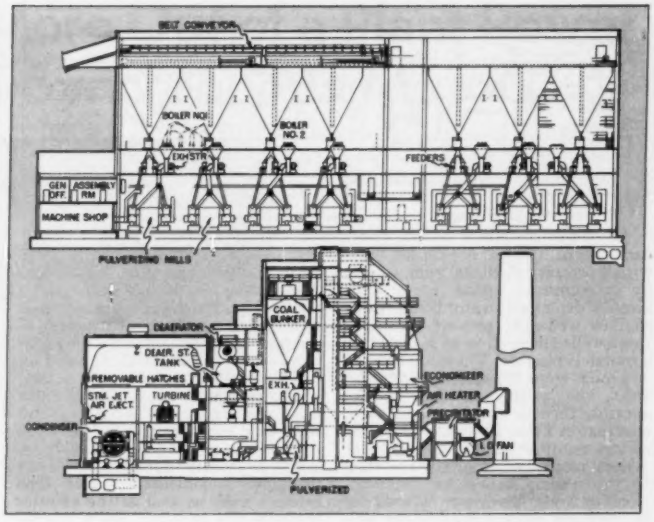


Fig. 6. Sections showing the general arrangement of equipment in the E. M. Poston Station

Principal Equipment For Units 1 and 2 of the E. M. Poston Generating Station of Columbus and Southern Ohio Electric Co.

BOILER EQUIPMENT

Boilers, 2—425,000 lb per hr at 1350 psig 955 F dry type Hopper bottom—outdoor, Foster Wheeler Corp.
Economizer Continuous loop counter flow type, Foster Wheeler Corp.
Air Heater Ljunstrom regenerative type—Vertical flow. Air Preheater Corp.
Soot Blowers Air blowing type. Diamond Power Specialty Corp.
Dust Collectors Multiclone type. Western Precipitation Corp.
F. D. Fans One per boiler—double inlet with outlet louvres, American Blower Corp.
F. D. Fan Drives Constant speed 350-hp Motors with hydraulic couplings by American Blower Corp.
I. D. Fan One per boiler—Sirocco type with double inlet boxes and outlet louvres, Gunite lined, American Blower Corp.
I. D. Fan Dran Drives Constant speed 700 hp motors with hydraulic couplings by American Blower Corp.
Pulverizers Two per boiler—double ended ball pulverizers, Foster Wheeler Corp.
Pulverizer Exhausters One per mill, Foster Wheeler Corp.
Coal Scales Two per boiler, Richardson Scale Co.
Coal Handling 300 tons per hour, Jeffrey Mfg. Co.
Ash Hopper Steel plate, The Allen-Sherman-Hoff Co.
Ash Handling System Jetpulsion pump system, United Conveyor Corp.
Fly Ash Handling System Hydroveyor system, United Conveyor Corp.
Stack One 200 ft for two boilers, reinforced concrete, brick lining, Rust Engineering Co.
Combustion Control Leeds and Northrup
Boiler Feedwater Regulators Bailey Meter Co.
Boiler Feed Pumps Three for two boilers, 475,000 lb per hr each, 3850 TDH, driven by 1500 hp Constant Speed Motors, Ingersoll Rand Co.
Air Compressors 2—550 cfm, 500 psig, driven by 200 hp synchronous motor, Sullivan Division of Jay Mfg. Co.
Piping Midwest Piping and Supply Co.
Pipe Insulation Johns Manville

TURBINE—GENERATOR EQUIPMENT

Turbines Two, 40/44,000 kw, 1250 psig, 950 FTT, two cylinder, tandum compound, condensing, Westinghouse Electric Corp.
Generator Two 44/40,000 kw, 0.85 pf, 3 phase, 60 cycles, 13,800 v, 3600 rpm, hydrogen cooled with direct connected exciter and pilot exciter, Westinghouse Electric Corp.
Condensers 37,500 sq ft, two pass, with divided water boxes, Worthington Pump and Machinery Corp.
Condensate Pumps Two per condenser, horizontal three stage Volute, 325,000 lb per hr capacity each, 125 hp motor drive, Worthington Pump and Machinery Corp.
Air Ejectors One per condenser—two stage twin jet with surface type inter and after cooler, Worthington Pump and Machinery Corp.
Circulating Water Pumps Two per condenser, 19,300 gpm, constant speed motor drive, Worthington Pump and Machinery Corp.
Cooling tower One for two condensers, 16 cell, induced draft, 86,000 gpm, 14 F approach to a wet bulb of 75 F, Foster Wheeler Corp.
Turb Oil Purification Bowser, Inc.
Closed Feedwater Heaters 4 stages per turbine, The Lummus Co.
Deaerating Feedwater Heater One for two units, 800,000 lb per hr, 60 psig, Worthington Pump and Machinery Corp.
Evaporator Preheater 30,000 lb per hr, deaerating Worthington Pump and Machinery Corp.

WATER TREATING EQUIPMENT

Wells, 3—60 in. shallow wells, Layne, Ohio.
Aerator Forced draft tray, stack type, 4000 gpm, Liquid Conditioning Corp.
Water Softening System Lime—alum., Liquid Conditioning Corp.
Evaporator Pretreatment 2—pressure water filters, 60 gpm each, 2—sodium zeolite softeners, 60 gpm each, Liquid Conditioning Corp.
Chlorination System Wallace and Tiernan.
Reservoir Pumps Two, 1000 gpm, Gardner Denver Co.
H. S. Pumps Three, 1000 gpm, Gardner Denver Co.
Elevated Storage Tank One, 50,000 gal, Chicago Bridge and Iron Works.
Ash Sluice Water Pumps Two, 1100 gpm, 200 hp Motors, Gould Pumps Inc.

ELECTRICAL EQUIPMENT

Power Transformers Two, 47,000 kva self-cooled 13,400—66,000/138,000 v, 3 phase, General Electric Co.
Aux. Transformers
Two, 6000 kva self-cooled 13,400—2400 v, 3 phase, Westinghouse Electric Corp.
One 600 kva self-cooled 66,000—2400 v, 3 phase, Westinghouse Electric Corp.
Two 1000 kva, self-cooled 2400—480 v, 3 phase, General Electric Co.
Cooling Tower Transformers Two 750 kva, self-cooled, 2400—480 v, 3 phase, General Electric Co.
Lighting Transformers Two 150 kva, self-cooled 2400—120/208 v, 3 phase, General Electric Co.
Substation 138,000 Breakers General Electric Co.
Substation 69,000 v Breakers Westinghouse Electric Corp.
Substation Structures and Switches Westinghouse Electric Corp.
Auxiliary Switchgear Westinghouse Electric Corp.
Electrical Control Boards Westinghouse Electric Corp.
Large Motors 2400 v Westinghouse Electric Corp.
Small Motors 480 v Westinghouse Electric Corp.

OTHER EQUIPMENT

Main Steel Ft. Pitt Bridge Works
Glazed Tile Hocking Valley Brick Co.
Air Conditioning Avery Engineering Co.
Precast Roof Slab Geo. Rackle and Sons
Roofing Theo C. Johnson
Gantry Crane 35 ton, Cobby Steel and Engineering Co.
Passenger Elevator Westinghouse Electric Corp.
Intercommunication Athens Home telephone system
Engineers and Construction Supervision Ebasco Services, Inc.

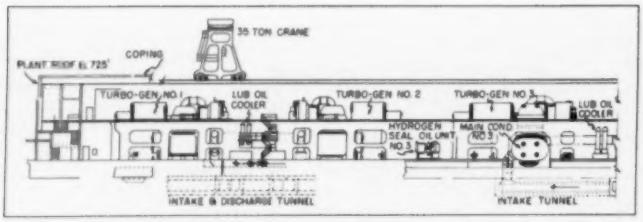


Fig. 7. Elevation of the turbine room showing crane running over roof

such pumps, two per condenser, each with a capacity of 19,300 gpm, driven by a constant speed motor. As already explained, water comes from shallow wells. At present there are three wells about 35 to 40 ft deep but a fourth is planned. These are located 1½ miles from the station. From the wells, the water goes first to the aerator, then to the lime and alum coagulator. From the latter the house service pump sends it to the plant for general plant cooling service and then to the cooling tower for make-up. Cooling tower blowdown is used for ash sluicing. Approximately two million gallons a day are used at present. The main condenser circulating pumps overcome the total head through the condensers and the cooling tower.

The Boiler Plant

The general arrangement of the boiler equipment is best described by reference to Fig. 6 which shows a cross-section of the entire station. With the exception of the firing equipment, and of course the control apparatus, the boilers, fans, dust collectors and air heaters are outdoors. Only the fronts of the boilers extend into the building. Coal is delivered by a belt conveyor extending the entire length of the top of the boiler house to a shuttle conveyor which in turn delivers the coal to the individual overhead bunkers, as shown on the diagram. The conveyors are sealed so that no coal dust escapes into the working areas. From the bunkers, the coal drops through automatic coal scales into pairs of feeders which in turn supply the pulverizers on the ground floor. There are four feeders, two mills and two exhausters per boiler in the first two units while the new boilers, as already stated, will have six feeders, three mills and three exhausters, as in Fig. 6.

Ash from the main ash hoppers is sluiced to a disposal area adjacent to the plant by a hydraulic sluicing system and the fly ash also is handled by a similar system.

The pulverizer room at this plant is astonishingly clean and attractive. The mills are encased in dust tight enclosures, painted an attractive green with the concrete foundations of the machines a contrasting color. The interior walls as well as the exterior walls of the building are of glazed tile, attractive in appearance and requiring practically no upkeep. The pulverizer room is practically free from coal dust.

Control

The control of the entire station is centered in one control room, centrally located, and isolated from the rest of the plant by virtue of its windowless tile walls. The boiler control panels occupy one side of the room and directly opposite are the electrical control boards. The turbine control panels are located at both ends of the room, the control for units 1 and 2 at one end and those for units 3 and 4 at the other end. The steam generators are under Leeds & Northrup combustion control.

One of the outstanding features about the operation of the E. M. Poston Station is the small number of personnel involved. With the 80,000 kw at present installed only 25 men including 4 shift supervisors but excluding superintendent and 2 other top supervisors, are needed for the operation of the entire station, over three 8-hour shifts.

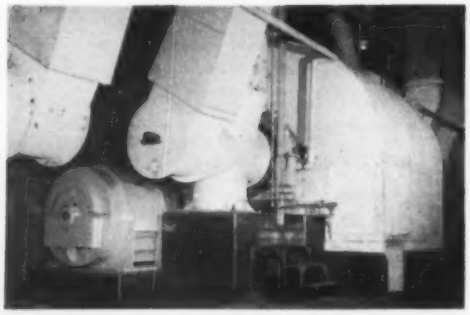


Fig. 8. A view in the pulverizer room. Note how completely all equipment is enclosed

The Turbine Room

As already mentioned, an unusual feature of the turbine room is its low ceiling, made possible by locating the crane above the roof. The three turbines (including the 60,000-kw unit now being installed) are placed endwise.

The condenser auxiliaries also are in the clear, away from the condensers. This provides an extremely convenient arrangement which should be reflected in improved maintenance.

The two generating units now installed are Westinghouse machines with Worthington condensers, rated 40/44,000 kw, 0.85 pf, 3-phase, 60-cycles, 13,800-v, 3600 rpm. The generators are hydrogen cooled and have direct connected exciters and pilot exciters.

The output of each generator is delivered to a 47,000-kw transformer for delivery to the Company's 69-kv and 138-kv transmission systems. Taps from the main leads of each generator feed a 6000 kva transformer supplying power to the auxiliaries in the plant at 2400 v. A 6000-kva transformer fed from the 69-kv bus supplies standby auxiliary power to the plant. Three-phase motors above 200 hp are supplied at 2400 v and 3-phase motors under 200 hp at 480 v. Single-phase motors are supplied at 110 v. Motor operated valves and other control motors are supplied through a 125-v motor generator set from a storage battery.

All air requirements are met by two 500 cfm, 500 psi compressors discharging to a 750 cu ft receiver tank. Air pressure reducing stations supplied from the 750 cu ft tank reduce pressure from 500 psi to the desired pressures for soot blowing, house service, and instrument uses.

The offices, locker rooms, turbine bay, auxiliary bay, and bunker bays are supplied evaporatively cooled air in the summer and heated air in winter. An assembly room is available for plant personnel meetings, and an all-electric kitchen provides facilities for the preparation of coffee and lunches during meetings and plant emergencies. A completely equipped first-aid room also has been provided. A chemical laboratory is available for making tests of coal, water, oil, etc., and, finally, a reforestation program has been started on the hills surrounding the plant to prevent erosion and to add to the natural beauty of the site.

Acknowledgment

In concluding this description, the editors acknowledge the co-operation of the engineers and officials of the Columbus and Southern Ohio Electric Co. in enabling them to present it. Particular credit is extended to Frank H. Streit, Chief Engineer of the Company, and to Harry P. Wilson, Senior Mechanical Engineer, for their help in supplying basic data and to M. L. Evans, Vice President, for his courtesies during our visit to the station.

How To Get More Out of a Plant Power System With Synchronous Motors

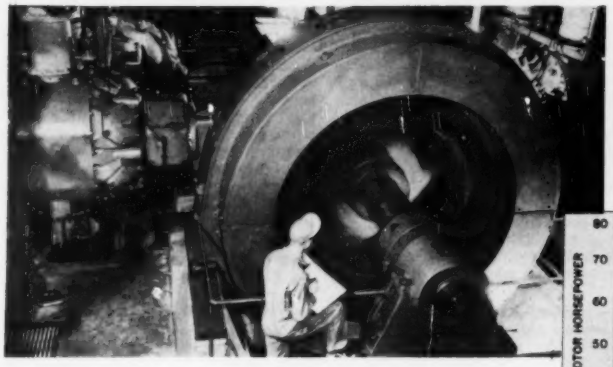


Fig. 1. (left) A 4500-hp G-E synchronous motor driving an air compressor

By J. C. MOORE

Large Motor and Generator Dept.
General Electric Company

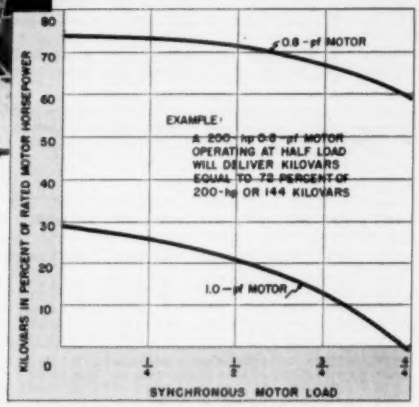


Fig. 2. Curves showing approximate kilovars supplied by synchronous motors

IN THESE DAYS of rapidly expanding production, with the consequent upswing in the installation of plant production machinery, many power engineers are concerned about increasing the load on power systems that are already loaded almost to capacity. Others are contemplating the addition of new power systems where existing systems obviously cannot handle an expanding load.

Pf.	Kvar	Pf.	Kvar
1.00	.000	.74	.909
.99	.142	.73	.936
.98	.203	.72	.964
.97	.251	.71	.992
.96	.292	.70	1.020
.95	.329	.69	1.049
.94	.363	.68	1.078
.93	.395	.67	1.108
.92	.426	.66	1.138
.91	.456	.65	1.169
.90	.482	.64	1.201
.89	.512	.63	1.233
.88	.540	.62	1.266
.87	.567	.61	1.299
.86	.593	.60	1.333
.85	.620	.59	1.368
.84	.646	.58	1.405
.83	.672	.57	1.442
.82	.698	.56	1.479
.81	.724	.55	1.508
.80	.750	.54	1.559
.79	.776	.53	1.600
.78	.802	.52	1.643
.77	.829	.51	1.687
.76	.855	.50	1.732
.75	.882		

Table 1 (left) Leading reactive kva per kw input for synchronous motors. Example: To find horsepower rating of 0.8 power factor synchronous motor required to furnish the 84.2 kvar determined by Fig. 2. Table shows an 0.8 power factor synchronous motor furnishes 0.75 kvar per kw input. The 84.2 kvar required divided by 0.75 equals 112.3 kw. Converting this value to approximate horsepower (neglect motor efficiency and divide by 0.746), we see that a 150-hp motor at 0.8 power factor would be recommended.

In either case, high plant power factors are of prime importance, because the load which any power system will carry is proportional to the plant power factor, which is expressed as KW load divided by the KVA load. The efficiency of the whole plant power system increases as the power factor approaches unity. A higher power factor may make it possible to safely increase the hp load on an existing system. It can also mean less investment in transformers, feeder lines, and voltage regulating devices where a new system is required.

Good operating conditions require high power factors, too. Poor power factor often results in voltage drops which increase the slip of induction motors to the point where production is adversely affected. If the voltage drops more than 10 per cent below normal, it is quite possible for induction motors to become overheated or stall. And high power system losses, poor plant lighting conditions, high power bills, and increased maintenance of the power supply commonly accompany poor power factor.

In most power systems, poor power factor is caused by excessive demands for magnetizing current (reactive kva) by induction motors at part loads, transformers, electric furnaces, electric welders, and other inductive equipment. This magnetizing current although necessary does no useful work, of course, and limits the power which a system can carry.

When a new motor drive (75 hp or larger) is needed in a plant, the installation of a synchronous motor can economically improve plant power factor. A unity power factor synchronous motor (current in phase with the voltage) accomplishes this by adding to the kw load on a power system without increasing the reactive kva load, since it needs no magnetizing current to operate when normally excited at full load. In other words, it brings the ratio $\frac{kw}{kva}$ closer to 1. For example, if a 1000-hp unity power factor synchronous motor is added to a 1000-hp plant load

having a power factor of 0.80, the new load of 2000 hp would have a power factor of 0.935.

A leading power factor synchronous motor (current leading the voltage) improves plant power factor because it acts as a kilovar generator, and can supply fairly large amounts of kilovars to a power system while performing its usual driving duties.

The ability of either unit power factor or 0.8 power factor synchronous motors to improve power factor is a function of load and excitation. Decreasing the mechanical load without changing the field excitation increases the reactive kva output of the motor. Fig. 2 shows the reactive kva that two typical synchronous motors will deliver under various load conditions with normal excitation. It is seldom economical to operate a synchronous motor at part load in order to gain greater power-factor improvement and the motor should never be over-excited for this purpose, as this practice can lead to serious overheating.

Another desirable characteristic of the synchronous motor with regard to its effect on the plant power supply is its tendency to stabilize the voltage. Under conditions of high voltage, the reactive kva furnished by a synchronous motor decreases, and under conditions of low voltage within reasonable limits, it increases. The motor, therefore, has a tendency to hold a constant voltage in the power supply.

Furthermore, synchronous motors usually have a higher full-load efficiency than any other type of motor, and produce a greater amount of work per dollar's worth of power consumed. Where loads are heavy and continuous, an advantage of from 0.5 to 3.0 per cent in efficiency saves a considerable sum in operating expense, and leaves more power available for other plant equipment. At reduced loads, the difference becomes greater to a marked degree, for an efficiency of 75 per cent at 5 per cent load has been attained in a synchronous motor.

Whether or not a synchronous motor should be installed for power factor correction depends upon several factors. A careful study might reveal that the particular plant and application might lend themselves better to induction motors and capacitors under certain conditions. The total cost, total load, present power factor, and amount of power factor improvement desired all have a bearing on the type of apparatus best suited for improving the power factor. And the provisions made for

(*Continued on page 92*)

Table II — Kw multipliers for determining kilovars required for power-factor improvement. Example: Plant has input of 200 kw at a power factor of 80 per cent. To find the reactive kva required to raise the plant power factor to a desired 95 per cent, multiply the 200 kw by the factor found in the table under 95 per cent opposite the original power factor of 80 per cent, or 0.421. Kvar required, therefore, is 200 x 0.421 or 84.2 kvar.

Original Power Factor (cos θ_1)	Desired Improved Power Factor (cos θ_2)																				
	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.0
0.50	0.982	1.008	1.034	1.060	1.086	1.112	1.139	1.165	1.192	1.220	1.248	1.278	1.306	1.337	1.369	1.403	1.440	1.481	1.529	1.589	1.732
0.51	0.937	0.962	0.989	1.015	1.041	1.067	1.094	1.120	1.147	1.175	1.203	1.231	1.261	1.292	1.324	1.358	1.395	1.436	1.484	1.544	1.687
0.52	0.893	0.919	0.945	0.971	0.997	1.023	1.050	1.076	1.103	1.131	1.159	1.187	1.217	1.248	1.280	1.314	1.351	1.392	1.440	1.500	1.643
0.53	0.850	0.876	0.902	0.928	0.954	0.980	1.007	1.033	1.060	1.088	1.116	1.144	1.174	1.205	1.237	1.271	1.308	1.349	1.397	1.457	1.600
0.54	0.809	0.835	0.861	0.887	0.913	0.939	0.966	0.992	1.019	1.047	1.075	1.103	1.133	1.164	1.196	1.230	1.267	1.308	1.356	1.416	1.559
0.55	0.769	0.795	0.821	0.847	0.873	0.899	0.926	0.952	0.979	1.007	1.035	1.063	1.093	1.124	1.156	1.190	1.227	1.268	1.316	1.376	1.519
0.56	0.730	0.756	0.782	0.808	0.834	0.860	0.887	0.913	0.940	0.968	0.996	1.024	1.054	1.085	1.117	1.151	1.188	1.229	1.277	1.337	1.480
0.57	0.692	0.718	0.744	0.770	0.796	0.822	0.849	0.875	0.902	0.930	0.958	0.986	1.016	1.047	1.079	1.113	1.150	1.191	1.239	1.299	1.442
0.58	0.655	0.681	0.707	0.733	0.759	0.785	0.812	0.838	0.865	0.893	0.921	0.949	0.979	1.010	1.042	1.076	1.113	1.154	1.202	1.262	1.405
0.59	0.619	0.645	0.671	0.697	0.723	0.749	0.776	0.802	0.829	0.857	0.885	0.913	0.943	0.974	1.006	1.040	1.077	1.118	1.166	1.226	1.369
0.60	0.583	0.609	0.635	0.661	0.687	0.713	0.740	0.766	0.793	0.821	0.849	0.877	0.907	0.938	0.970	1.004	1.041	1.082	1.130	1.190	1.333
0.61	0.549	0.575	0.601	0.627	0.653	0.679	0.706	0.732	0.759	0.787	0.815	0.843	0.873	0.904	0.936	0.970	1.007	1.048	1.096	1.156	1.299
0.62	0.516	0.542	0.568	0.594	0.620	0.646	0.673	0.699	0.726	0.754	0.782	0.810	0.840	0.871	0.903	0.937	0.974	1.015	1.063	1.123	1.266
0.63	0.483	0.509	0.535	0.561	0.587	0.613	0.640	0.666	0.693	0.721	0.749	0.777	0.807	0.838	0.870	0.904	0.941	0.982	1.030	1.090	1.233
0.64	0.451	0.474	0.503	0.529	0.555	0.581	0.608	0.634	0.661	0.689	0.717	0.745	0.775	0.806	0.838	0.872	0.909	0.950	0.998	1.058	1.201
0.65	0.419	0.445	0.471	0.497	0.523	0.549	0.576	0.602	0.629	0.657	0.685	0.713	0.743	0.774	0.806	0.840	0.877	0.918	0.966	1.026	1.169
0.66	0.388	0.414	0.440	0.466	0.492	0.518	0.545	0.571	0.598	0.626	0.654	0.682	0.712	0.743	0.775	0.809	0.846	0.887	0.935	0.995	1.138
0.67	0.358	0.384	0.410	0.436	0.462	0.488	0.515	0.541	0.568	0.596	0.624	0.652	0.682	0.713	0.745	0.779	0.816	0.857	0.905	0.965	1.108
0.68	0.328	0.354	0.380	0.406	0.432	0.458	0.485	0.511	0.538	0.566	0.594	0.622	0.652	0.683	0.715	0.749	0.786	0.827	0.875	0.935	1.078
0.69	0.299	0.325	0.351	0.377	0.403	0.429	0.456	0.482	0.509	0.537	0.565	0.593	0.623	0.654	0.686	0.720	0.757	0.798	0.846	0.906	1.049
0.70	0.270	0.296	0.322	0.348	0.374	0.400	0.427	0.453	0.480	0.508	0.536	0.564	0.594	0.625	0.657	0.691	0.728	0.769	0.817	0.877	1.020
0.71	0.242	0.268	0.294	0.320	0.346	0.372	0.399	0.425	0.452	0.480	0.508	0.536	0.566	0.597	0.629	0.662	0.700	0.741	0.789	0.849	0.992
0.72	0.214	0.240	0.266	0.292	0.318	0.344	0.371	0.397	0.424	0.452	0.480	0.508	0.538	0.569	0.601	0.635	0.672	0.713	0.761	0.821	0.964
0.73	0.186	0.212	0.238	0.264	0.290	0.316	0.343	0.369	0.396	0.424	0.452	0.480	0.510	0.541	0.573	0.607	0.644	0.685	0.733	0.793	0.936
0.74	0.159	0.185	0.211	0.2237	0.263	0.289	0.316	0.342	0.369	0.397	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766	0.909
0.75	0.132	0.158	0.184	0.210	0.236	0.262	0.289	0.315	0.342	0.370	0.398	0.426	0.456	0.487	0.519	0.553	0.590	0.631	0.679	0.739	0.882
0.76	0.105	0.131	0.157	0.183	0.209	0.235	0.262	0.288	0.315	0.343	0.371	0.399	0.429	0.460	0.492	0.526	0.563	0.604	0.653	0.712	0.855
0.77	0.079	0.105	0.131	0.157	0.183	0.209	0.236	0.262	0.289	0.317	0.345	0.373	0.403	0.434	0.466	0.500	0.537	0.578	0.626	0.686	0.829
0.78	0.052	0.078	0.104	0.130	0.156	0.182	0.209	0.235	0.262	0.290	0.318	0.346	0.376	0.407	0.439	0.473	0.510	0.551	0.599	0.659	0.802
0.79	0.026	0.052	0.078	0.104	0.130	0.156	0.183	0.209	0.236	0.264	0.292	0.320	0.350	0.381	0.413	0.447	0.484	0.525	0.573	0.633	0.776
0.80	0.000	0.026	0.052	0.078	0.104	0.130	0.157	0.183	0.210	0.238	0.266	0.294	0.324	0.355	0.387	0.421	0.458	0.499	0.547	0.609	0.750
0.81		0.000	0.026	0.052	0.078	0.104	0.131	0.157	0.184	0.212	0.240	0.268	0.298	0.329	0.361	0.395	0.432	0.473	0.521	0.581	0.724
0.82			0.000	0.026	0.052	0.078	0.105	0.131	0.158	0.186	0.214	0.242	0.272	0.303	0.335	0.369	0.406	0.447	0.495	0.555	0.698
0.83				0.000	0.026	0.052	0.079	0.105	0.132	0.160	0.188	0.216	0.246	0.277	0.309	0.343	0.380	0.421	0.469	0.529	0.672
0.84					0.000	0.026	0.053	0.079	0.106	0.134	0.162	0.190	0.220	0.251	0.283	0.317	0.354	0.395	0.443	0.503	0.646
0.85						0.000	0.027	0.053	0.080	0.108	0.136	0.164	0.194	0.225	0.257	0.291	0.328	0.369	0.417	0.477	0.620
0.86							0.000	0.026	0.053	0.081	0.109	0.137	0.167	0.198	0.230	0.264	0.301	0.342	0.390	0.450	0.593
0.87								0.000	0.027	0.055	0.083	0.111	0.141	0.172	0.204	0.238	0.275	0.316	0.364	0.424	0.567
0.88									0.000	0.028	0.056	0.084	0.114	0.145	0.177	0.211	0.248	0.289	0.337	0.397	0.540
0.89										0.000	0.028	0.056	0.086	0.117	0.149	0.183	0.220	0.261	0.309	0.369	0.512
0.90											0.000	0.028	0.058	0.089	0.121	0.155	0.192	0.233	0.281	0.341	0.484
0.91												0.000	0.030	0.061	0.093	0.127	0.164	0.205	0.253	0.313	0.456
0.92													0.000	0.031	0.063	0.097	0.134	0.175	0.223	0.283	0.426
0.93														0.000	0.032	0.066	0.103	0.144	0.192	0.252	0.395
0.94															0.000	0.034	0.071	0.112	0.160	0.220	0.363
0.95																0.000	0.037	0.079	0.126	0.186	0.329
0.96																	0.000	0.041	0.089	0.149	0.292
0.97																		0.000	0.048	0.108	0.251
0.98																			0.000	0.060	0.203
0.99																				0.000	0.143
																					0.000

Winter Meeting of AIEE Largest on Record

Over 3900 engineers from all parts of the country attend Winter General Meeting of the American Institute of Electrical Engineers

WINTER General Meeting of the American Institute of Electrical Engineers, held at the Statler Hotel in New York the week of January 21, was the largest meeting in the 68-year history of the Institute. It was attended by a total of 3925 engineers from all parts of the United States and Canada, and some from other foreign countries. The almost 300 technical papers presented at 66 different sessions covered every aspect of the electrical art, from the influence of the planets upon radio and wire transmission to developments in turbine-generator design.

Chief element of interest at the General Session, the first day of the meeting, was the address by Charles E. Wilson, director of Defense Mobilization, entitled, "Building For Strength." Mr. Wilson's forceful address, outlining the task of mobilizing the technical and physical resources of the country, reflected his sincerity in the undertaking and his eminent fitness for the job. As he put it, he would have no stomach for the job if he did not believe that the world-wide contest of the free world and the Soviet Union is one that goes to the very roots of man's reasons for being on earth. The nature of the conflict that now divides the world is such as to demand, on the part of the United States and all our friends in the free world, a marshaling of physical resources to so formidable a point as to strike dread into the mind and heart of any aggressor.

It was at the General Session, also, that the 1951 Edison Medal, the Institute's highest award, was presented to Charles F. Wagner of Westinghouse Electric Corp. In Mr. Wagner's case, the award was made for his distinguished contributions in the field of power system engineering.

The Alfred Noble Prize, for the best 1951 Institute paper by an engineer under 30, was presented to Eldo C. Koenig of the Allis-Chalmers Mfg. Co. The title of this paper was, "An Electric Analogue Computer using the Photocell as a Non-linear Element."

The Engineer in Society

Professor F. O. McMillan, President of the AIEE, in his address at the General Meeting, stressed the obligations of the engineer to society, not only in his professional activities, but also in his social, economic and political activities. In this technological age, there are many enterprises affecting the public security, health and general welfare that can only be clearly analyzed and evaluated by engineers. This condition, said Professor McMillan, places a grave responsibility upon the engineering profession. If we fail to meet these obligations, the public will hold us fully accountable for our failures.

Professor McMillan stressed the importance of making the public more aware of engineers and their accomplishments — the fact is that, at present, the public has little interest in engineering. One reason for this lack of interest was discussed when three educators from New York University explained how engineers could clarify and not mystify when they speak or write technical papers. Ormand J. Drake and George R. Sargent showed how to "Humanize Technical Speech" and E. J. McAdam, Jr. spoke on "Writing Visually." Dean Drake said he used the word "humanizing" with "cruel and deliberate intent" because most technical speeches are not human. Of course, he said, this is no more an indictment of engineers than it is of teachers, doctors, undertakers, lawyers, economists or artists, but, it does apply to engineers as a class.

No attempt could possibly be made in this brief report of the meeting to give details of even a small percentage of the 300 odd papers presented at this meeting. As already mentioned, they covered the entire gamut of electrical engineering in all its multitudinous applications in industry and society. Applications of electronics received a great deal of attention, and the design and use of electric computers was discussed in many papers. Metallic Rectifiers also were given an entire session and at this session a new industrial germanium rectifier was described by E. A. Harty of General Electric. By use of a discovery of a method of synthetically reproducing the marvelous inherent rectification properties occasionally found in germanium in its natural state, it has been found possible to control the manufacture of processed germanium rectifiers with these same rectification properties. A rectifier, about the size of a dime, made by this process, is capable of handling a load of around 2 kw.

More detailed discussion of some of the more important papers of interest to power engineers will be presented in subsequent issues.

Fig. 1. Below. Fred O. McMillan of Oregon State College, Corvallis, president AIEE (left), presenting Edison Medal and scroll to Dr. Charles F. Wagner, Westinghouse Electric Corp. consulting engineer

Fig. 2. Right. Charles E. Wilson, Director of the Office of Defense Mobilization, speaking at the opening session of the AIEE Winter General Meeting in the Hotel Statler, N. Y., January 21, 1952

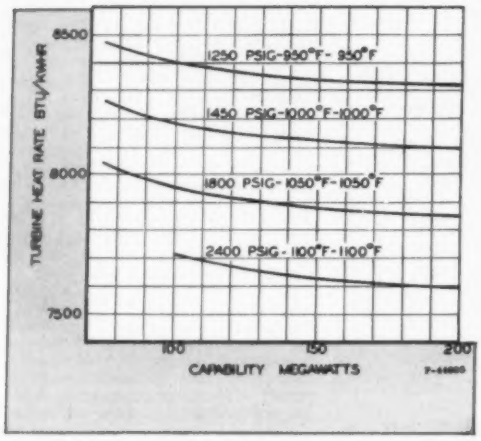


Fig. 1. Turbine heat rate versus capability load, for Westinghouse non-reheat turbine generator units. Exhaust pressure 1.5 in. Hg abs; 5 stages feedwater heating

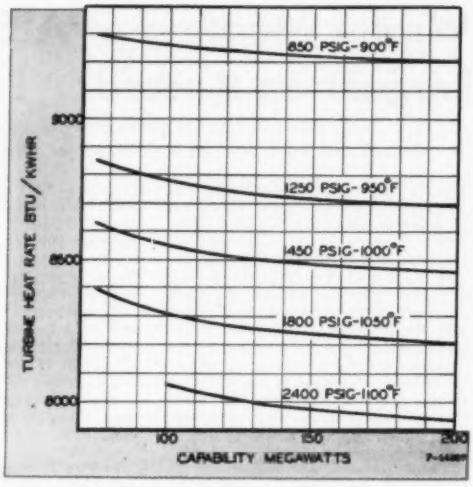


Fig. 2. Turbine heat rate versus capability load for Westinghouse reheat turbine generator units. Exhaust pressure 1.5 in. Hg abs; 5 stages feedwater heating

How to Figure Heat Rates of Big Modern Turbines

Two teams of authors tell ASME annual meeting how to estimate and calculate heat rates, throttle and condenser flows, extraction for feedwater heating, turbine efficiencies and expansion lines and, in general, predict turbine performance with practical accuracy for units installed since 1941 and units up to 200,000 kw projected for future . . . Data are given for steam conditions up to 2400 psig, 1100 F, 1.5 in. Hg abs and for both reheat and non-reheat units in capacities up to 200,000 kw . . . These data extend the calculations and curves far beyond the 1250-psi units calculated before 1941 . . . These two papers will help engineers to plan economical power plants and to evaluate their status

AT THE ANNUAL meeting of the ASME at Atlantic City, N. J., November 25–30, 1951, two papers on large steam turbine performance were presented by engineers of two large turbine manufacturers. These papers complement each other. One paper was Thermal Performance of Modern Turbines by H. R. Reese [1] and J. R. Carlson [2] of Westinghouse Electric Corp. The other was Comparative Efficiencies of Central Station Reheat and Non-Reheat Steam Turbine-Generator Units by C. W. Elston [3] and P. H. Knowlton [4] of General Electric Co.

These papers will be published in full by the ASME, either in *Mechanical Engineering* or in the *Transactions* of the Society. Complete copies will also be available from the respective manufacturers. The following is a very brief abstract of both papers, primarily to show the type of data they contain. They should be of value to all users of steam turbines in the utility field.

Westinghouse Paper

The paper by Reese and Carlson of Westinghouse is primarily an extension of the data originally presented in 1945 in the Westinghouse bulletin *Steam Power Plant Planning Guide*. It presents data on which rapid estimates suitable for preliminary central station design can be based, giving enough data to limit alternatives to three or four.

Reese and Carlson first review the earlier studies for straight condensing turbines as given in the 1945 *Planning Guide*. These gave steam rates for units operating at 4 different initial steam conditions: 400 psig, 750 F; 600 psig, 825 F; 850 psig, 900 F; 1250 psig, 950 F. Of all the thousands of kw of turbines purchased before 1940, practically all can be grouped in those four classes of steam conditions. These permitted a choice, any one of which could result in economical steam plants. They are all matched to give reasonable moisture conditions in the lower pressure turbine stages.

[1] Assistant Section Manager, Westinghouse Electric Corp. Steam Division, Philadelphia 13, Penna.
[2] Application Engineering Manager, Westinghouse Electric Corp. Steam Division, Philadelphia 13, Penna.
[3] Division Engineer, Steam Turbine Engineering Division, General Electric Co., Schenectady, N. Y.
[4] Thermodynamic Engineer, Turbine Division, General Electric Co., Schenectady, N. Y.

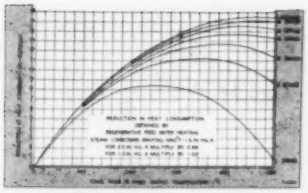


Fig. 3. Reduction in heat consumption obtained by regenerative feedwater heating, Westinghouse turbine generator units

Calculations for Conditions Up to 1250 psig, 950 F

Superheat correction factors, established for years, are tabulated and shown by a curve. Then turbine generator efficiencies for the 4 steam conditions above were calculated for four different exhaust pressures and vacuum correction curves obtained. These and other related data were tabulated for full and partial loads at the various initial steam and exhaust conditions. Reynolds of Westinghouse had developed curves showing improvement in heat rates with various numbers of feed heating stages. Using these data, turbine generator heat rates could be tabulated for a whole range of turbine sizes and steam conditions. Such basic data were printed in 1945 as the *Planning Guide*, which set forth the heat rates obtained with various numbers of feedwater heaters from 0 to 5 stages, and for four initial steam conditions and three exhaust pressures. Boiler feed pump power, rise of liquid enthalpy due to compression, heat absorbed in air ejector condenser, hydrogen or air coolers and oil coolers were not included in calculations for the *Planning Guide* nor for the heat balance calculations in the present paper.

New Steam Conditions Up to 2400 psig, 1100 F

The 1945 *Guide* is still a useful tool for units with steam conditions up to 1250 psig, 950 F and largest turbine rating of 60,000 kw. But today, single-shaft 3600-rpm turbine generators of 150,000 kw capability will soon be shipped and single-shaft ratings of 185,000 and 200,000 kw have already been undertaken. Steam pressures for larger ratings vary upward to 1800 or 2000 psig. One 3600-rpm turbine of 185,000 kw capability is being designed for 2350 psig, 1100/1050 F.

Accordingly, heat rates of 75,000-kw to 200,000-kw non-reheat units have been calculated and are given in curve form in this paper, for the following steam conditions: 850 psig, 900 F; 1250 psig, 950 F; 1450 psig, 1000 F; 1800 psig, 1050 F; 2400 psig, 1100 F — all at 1.5 in. Hg abs exhaust pressure and 5 stages of regenerative feedwater heating.

For these, throttle flows, heater extraction factors, initial and feed enthalpy are tabulated and graphed in the present paper. Taking a specific turbine unit and its steam conditions, condenser and heater flow calculations are shown. Correction factors are given for initial pressure and temperature, exhaust pressure, number of feed heating stages and terminal difference on top heater.

Data for Large Reheat Turbines

Following this, heat rates of large reheat turbines are calculated and shown in curve form for: 1250 psig, 950/950 F; 1450 psig, 1000/1000 F; 1800 psig, 1050/1050 F; 2400 psig, 1100/1100 F — all at 1.5 in. Hg abs back pressure and with 5 stages of feedwater heating. Calculations are made for throttle, reheater and condenser flows. Correction factors for variations from the five basic ones are the same as for non-reheat units except the initial and reheat temperature factors, for which curves are given.

General Electric Paper

The second paper, by Elston and Knowlton of GE, arrives at its comparisons of turbine performance by considering more of the details of the turbine design; its data are based on test results accumulated in the last decade. A previous GE paper in 1941 gave similar data on the practice up to that time, but with no particular reference to reheat machines, which have become much more popular in the past few years.

The present GE paper explains the range of test results obtained since 1940. They are plotted against equivalent nozzle area, to be used later in the calculations. Equivalent nozzle area is the area of a perfect nozzle required to pass the same flow as the turbine, at throttle steam conditions and with a critical pressure ratio. A curve is given from which actual flow capacity can be determined for given steam conditions, in terms of equivalent nozzle area. From the test data, the authors derived turbine efficiency curves for performance prediction, explaining that while inlet flow capacity alone is much too simple and is not presented as satisfactory for all turbines, still it is adequate for predicting overall performance for all practical purposes.

Here also, the data cover units up to 200,000 kw and steam conditions up to 2400 psig 1100 F and some of the curves show conditions up to 3000 psi, 1600 F.

Heat Rates for Non-Reheat Machines

The paper then details the method for arriving at output for single-cylinder and tandem-compound units. Power generated by the turbine wheels must first be found, from which mechanical losses, read from a curve, must be deducted to give shaft power, which in turn is multiplied by generator efficiency, from another curve, to obtain generator terminal power output.

The resulting generator terminal output, with the steam and water flows and heat content to and from the turbine and heaters, will give the overall heat rate of the combination.

Method for Reheat Turbines

It is useful to consider the reheat turbine as made up of two separate sections and the paper shows various arrangements of these now in use. The high-pressure section efficiency

(*Continued on page 96*)

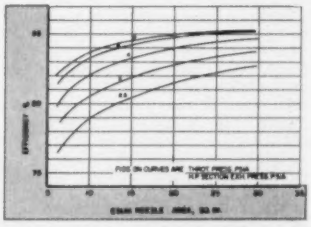


Fig. 5. Internal efficiency of high-pressure sections of large General Electric reheat and cross-compound non-reheat turbines, 3600 rpm

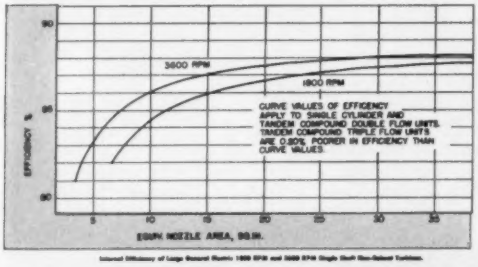

3600 RPM
1800 RPM
CURVE VALUES OF EFFICIENCY APPLY TO SINGLE CYLINDER AND TANDEM COMPOUND DOUBLE FLOW UNITS. TANDEM COMPOUND TRIPLE FLOW UNITS ARE 0.50% POORER IN EFFICIENCY THAN CURVE VALUES.
EFFICIENCY %
EQUIV. NOZZLE AREA, SQ. IN.

Fig. 4. Internal efficiency of large General Electric 1800-rpm and 3600-rpm single-shaft non-reheat turbines

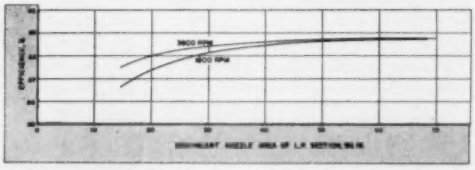
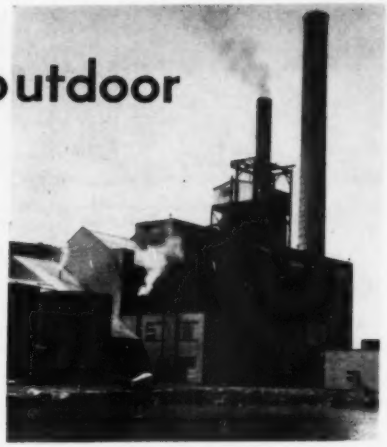


Fig. 6. Internal efficiencies of low-pressure sections of large General Electric reheat and cross-compound non-reheat turbines, 1800 rpm and 3600 rpm. Seven combinations of high and low pressure sections, with correction factors for various arrangements, shown in complete paper but omitted here

Morton Salt's Semi-outdoor Boiler



New semi-outdoor boiler installed to replace old boilers and meet expanding electric power and process needs. . . . Air flow-steam flow compensated combustion control used effectively. . . . Boiler handles load swings up to 80,000 lb per hr at 85 per cent efficiency. . . . Minimum maintenance

IN 1949, THE Morton Salt Co. at Manistee, Michigan, which is the nation's largest salt works, found it necessary to install a new boiler to meet their expanding electric power and process steam needs. Despite the northerly location (44 N lat) it was decided to install a large semi-outdoor unit with air flow-steam flow compensated combustion control.

The power plant now contains four 1043-hp old boilers used for stand-by service, a Wickes 60,000 lb per hr, 500 F boiler designed to operate at 200 psig, and the new unit. The new boiler is a Wickes 4-drum, water walled, fully steel encased steam generator with furnace of suspended wall construction and fired by a spreader stoker. This boiler, designed for 225,000 lb per hr at 700 psig and 750 F total temperature, at present is being operated at 180 psi and 500 F. The sides of the boiler, the firing aisle at the front, and the reinjection pipes at the back are enclosed. In addition, the motor-driven, induced draft fan located 100 ft above the ground is enclosed by a small housing. The motor-driven forced draft fan is installed in the basement on a heavy concrete base.

The Detroit Stoker Co.'s spreader stoker, equipped with a forward moving grate that discharges ash continuously at the front, has six feeders and a 23-ft wide grate providing over 370 sq ft of active fuel burning surface.

Feedwater

Raw water for all plant purposes is obtained from Manistee Lake through two traveling screens of 30,000 gpm capacity. Water for boiler make-up is first put through a zeolite softener and a secondary phosphate treatment is added internally. Boiler make-up, however, averages less than two per cent since condensate is returned in large quantities from the first and second effects of multiple vacuum pans.

A continuous blow-down system is employed with the new boiler, the blow-down averaging about five per cent to keep the boiler concentration at approximately 2500 ppm total solids.

Coal and Ash Handling

A low cost grade of coal from Kentucky is used. It is received by boat and stored in a large storage area. The coal is moved from the storage area by a drag line scraper and fed into a crusher. From here it goes by belt conveyor to a continuous bucket elevator conveyor that serves the 1000-ton overhead bunker in front of the boilers. The new boiler, and the 60,000 lb per hr unit which is operated most of the time, are directly opposite each other. Because of this, a continuous enclosed type of bulk flow conveyor was installed below that part of the bunker which could not feed directly to these two boilers. Coal feeds by gravity into this conveyor and is carried through the bunker and over the top of the bunker section between the operating boilers.

Ash is discharged from the stoker ash hoppers into a 20-in. wide trough or sluiceway. Water is pumped through the sluiceway continuously to carry away the ash. The mixture is carried to an area a short distance

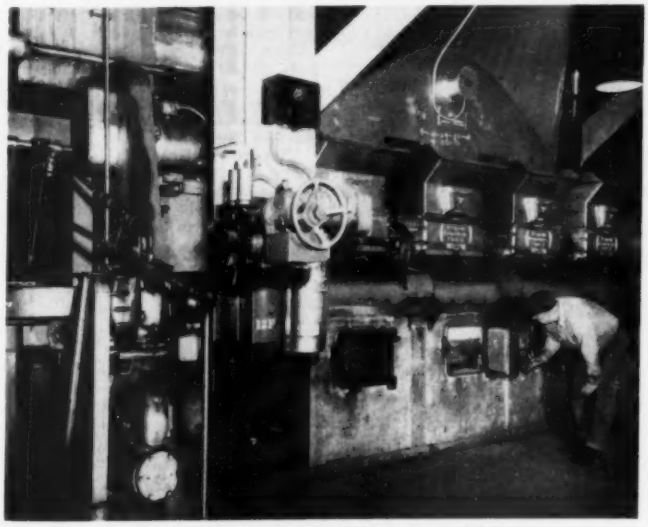


Fig. 1. Firing aisle view of spreader stoker for new boiler

from the power plant on the shore of Manistee Lake.

Use of Steam

Steam loads average around 200,000 lb per hr with the smaller boiler carrying a constant load of 40,000 lb per hr and the new one carrying the remainder. Most of the steam generated is first used in three turbine generator units. Two of the turbines are rated 1500 kw each and are of the extraction-condensing type. The third one is rated 600 kw and is a non-condensing machine.

Most of the steam is used in evaporating flake salt at atmospheric pressure and evaporating granulated salt by multiple vacuum pan condensers in the processing departments.

Combustion Control

The combustion control on the new 200,000 lb per hr boiler is the Hays all-electric system, shown schematically in Fig. 3. It consists of a master controller actuated from the main steam pressure, a fuel-feed controller, an air-flow controller, an over-fire air controller, and a combination furnace-draft and load-limiting controller. In addition, a boiler efficiency meter is connected to the air-flow controller as shown. The latter measures the flow of steam from the boiler and also the combustion gases flowing through the boiler by measuring the draft loss across the boiler baffling. An electrical contact in this meter (operated by the relationship between steam flow and air flow) is used to compensate or readjust the air-flow controller to maintain the desired relationship between flow of steam and air.

The meters and control equipment for this system, together with that for the 60,000 lb per hr boiler is grouped on a single control panel. Among the principal items on this panel are the following: steam pressure gage, Hays 10-point draft gage, Hays-Penn feedwater flow indicator, feedwater recording and integrating flow meter, efficiency meter, economizer water and gas temperature recorder, feedwater pressure gage, and recording steam, feedwater pressure and feedwater suction temperature meter. In addition, the panel contains the necessary controllers, signal lights, annunciator, etc.

Results

The boiler has operated very successfully with this combustion control system. The sensitivity and quick response of the control in automatically handling sudden load increases and reductions up to 80,000 lb per hr has been very satisfactory. Furthermore, the high CO_2 percentages of 12.5 to 13.5 per cent, the absence of smoke, the high efficiency of approximately 85 per cent, and the minimum amount of maintenance required for the control is further evidence that the control is doing a good job.

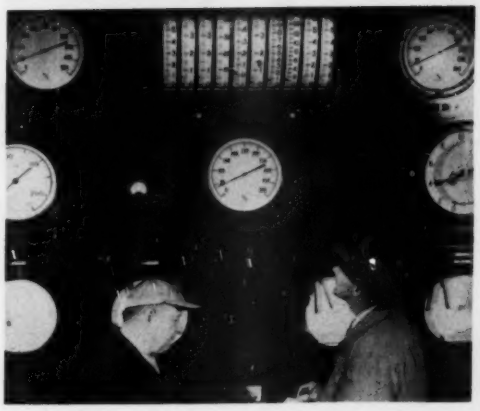


Fig. 2. View of control board showing some of the instruments necessary for efficient operation

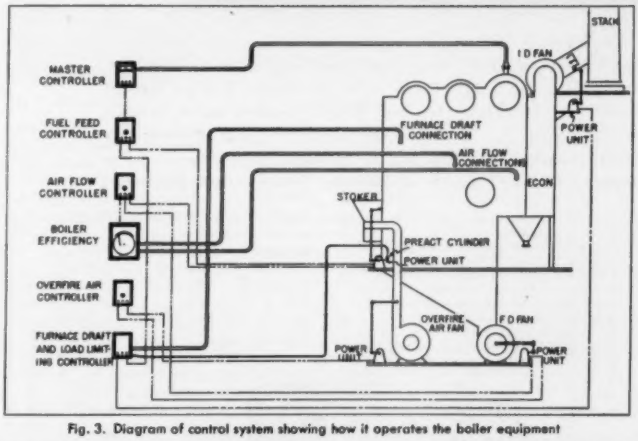


Fig. 3. Diagram of control system showing how it operates the boiler equipment

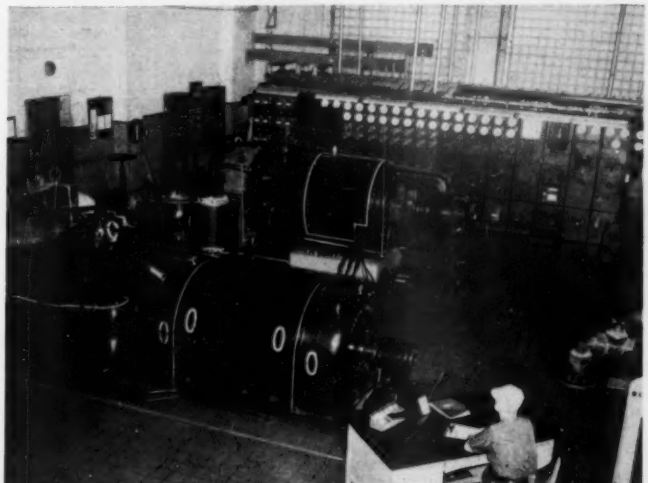


Fig. 4. Generating room showing two of the three turbine-driven generators and main electric power control board in rear

Steam for Chicago's

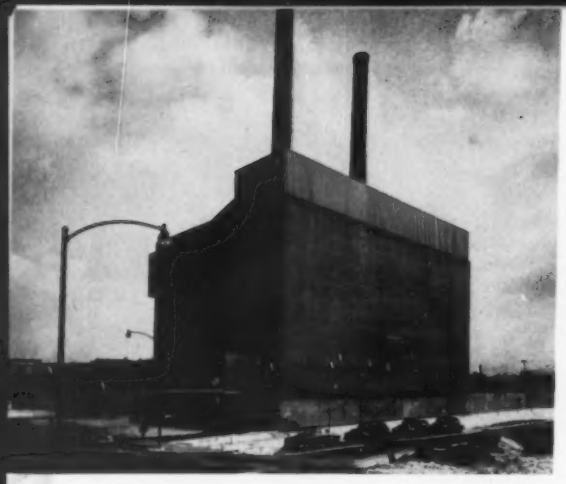


Fig. 1. Exterior view of Medical Center Steam Plant. Office bay of glass and aluminum projects from end of steel and brick building. Other end of building is prefabricated aluminum siding, so future extension may be made in that direction

Medical Center Steam Co., formed as an Illinois public utility, builds steam plant and distribution system to supply University of Illinois and, through it, other buildings now under construction in great medical center . . . Steam plant has three 90,000-lb-per-hr boilers, fired by coal, gas or oil . . . Design for absolute reliability of service to hospitals and other institutions and for maximum cleanliness . . . Produces no electricity; that is supplied by Commonwealth Edison Co.

TO SUPPLY steam for the great Medical Center now developing rapidly on Chicago's near West Side, the new steam plant shown here has been built. It went into operation officially in July 1951, supplying steam from its first boiler. The plant supplies all steam to the University of Illinois group of buildings in the Medical Center and the University in turn supplies it to the other institutions in the District. Electricity is not generated in the plant, but is supplied for plant use by the Commonwealth Edison Co.

The steam plant contains three boilers, each with a rated capacity of 90,000 lb per hr, designed for firing with coal on chain grate stokers or alternately with fuel oil, and with gas available in summer. Since continuity of service to the medical buildings is the primary requirement, the plant was designed to supply present maximum steam requirements with two boilers, the third being a standby, and with provision for expansion.

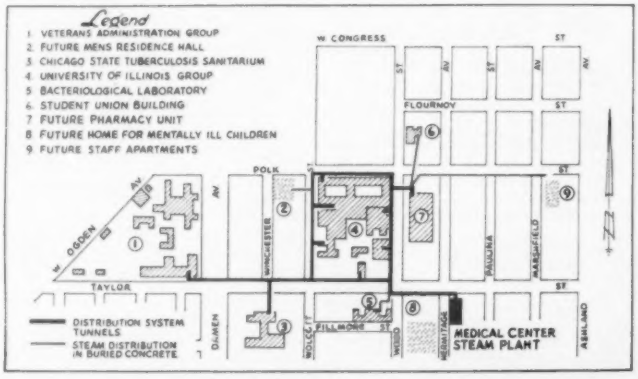


Fig. 2. Diagram of Medical Center District in Chicago, showing buildings of development served or to be served, some now under construction. Steam distribution system from steam plant shown in red

Steam Plant a Public Utility

The steam plant has been built by the Medical Center Steam Co., an Illinois public utility, formed in 1949 as a subsidiary of the Commonwealth Edison Co. The University's own steam plant had become obsolete and state funds for new facilities were not available. So the University requested Commonwealth Edison Co. to build the steam plant and distribution system with private capital.

The University will pay for the entire steam output of the plant, the charges for steam being only enough to cover operating and investment costs over a 30-year period. The University will bill surrounding institutions for steam used by them. At the end of the 30-year period, or sooner if the University so elects within terms of its contract with the Company, the property will be transferred to the University of Illinois. The University,

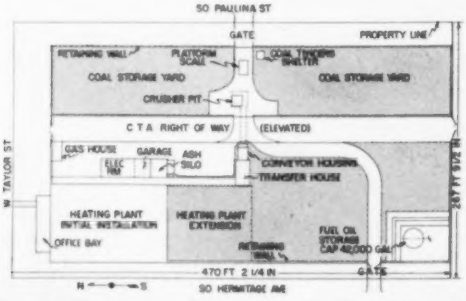


Fig. 3. General arrangement of Medical Center Steam Plant. Existing CTA elevated railway structure runs over part of property. Plan shows how three fuel supplies are provided

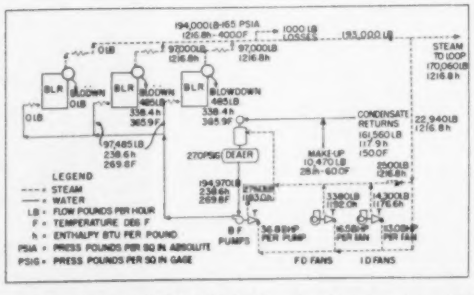


Fig. 4. Heat balance of Medical Center Steam Plant for steam demand of 170,000 lb per hr. Note auxiliary turbines' exhaust heating feedwater, high proportion of which is condensate. Steam pressure controlled from a point on steam distribution system, not from boiler header pressure

Great and Growing Medical Center

meanwhile, will furnish the personnel and other services for operating the steam plant but the steam company will be responsible for its operation.

Three Fuels Insure Service Continuity

The steam plant, as shown, is a steel, concrete and brick structure, located on the plant property as in Fig. 3. A coal storage yard, surrounded by a concrete wall, is provided for dead storage of approximately 7000 tons of coal, about 45 days supply. All coal will be delivered to the plant by truck, weighed on a platform scale and either delivered to the underground crusher hopper or to the storage pile, in which it is distributed and compacted by a tractor bulldozer, which will also reclaim it.

Coal delivered to the receiving hopper, by bulldozer or truck, is first crushed, if required, to uniform fineness, then transported by inclined belt conveyors to the overhead bunkers, where a distributing belt conveyor and tripper load it into the bunkers.

The plant is also designed to burn oil, as protection against any interruption in coal supply. A 42,000-gal oil storage tank is installed, Fig. 3, with suitable oil pumping and heating system. A gas connection with the Peoples Gas Light & Coke Co. also supplies gas, which is the principal fuel in summer, at established commercial rates.

Coal is burned on chain grate stokers, which were selected because the load can be predicted accurately and follows a regular pattern, hence the flexibility of other types of firing equipment in following load swings is not required here. Both forced and induced-draft fans are installed.

Because the plant is surrounded by hospitals, laboratories and other medical buildings, every effort has been made to minimize dirt and dust nuisance. This begins with correct furnace design, provision of over-fire air, air aspirating steam jets and complete automatic combustion control to maintain most efficient combustion. Each boiler is equipped with a mechanical dust collector to remove dust from flue gas before it is discharged high in the air by the stacks.

The surface of the compacted coal pile will be sealed, if necessary. Ash is handled by a completely sealed vacuum transport system incorporating special devices to prevent dust emissions to the air. Hence maximum cleanliness of the plant will be assured.

This heating plant and associated steam distribution system were designed on the basis that nearly all the condensate from the system — normally 90–95 per cent, Fig. 4 — would be returned for boiler feed.

Fig. 5. General interior view of plant showing three 90,000-lb-per-hr boilers, fired by coal, oil or gas

To supply the required make-up, Chicago city water is taken from either of two water mains, treated in a zeolite softening and filtering system and deaerated in a deaerating feedwater heater, Fig. 4. As supplementary treatment, phosphate and sulphite are fed directly to the boiler drums by chemical proportioning pumps.

The entire water treatment system is oversized, its maximum make-up capacity for 4 hr being twice normal capacity, so that it will be possible to waste about 50,000 lb per hr of condensate from the Veteran's Administration group of buildings under certain operating conditions.

Steam and water piping and headers in the plant are installed in duplicate and designed in such a way that a header may be taken out of service or any valve replaced without shutdown.

The steam generating units are

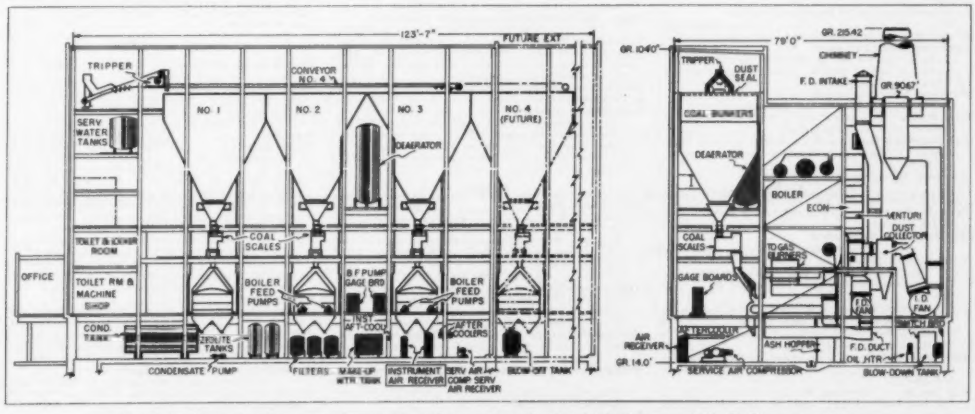


Fig. 6. Longitudinal and transverse cross-sections of steam plant, showing simple design, provision for future expansion

designed to generate steam at 200 psi, 415 F but will operate normally at a somewhat lower pressure. This pressure will vary, because the units are controlled either manually or automatically to maintain constant steam pressure at the point where the feeder lines enter the distribution loop at the intersection of Taylor and Wood Streets, rather than maintaining constant boiler drum pressure. The boilers are equipped with superheater surface to provide about 35 F of superheat, to insure dry saturated steam at the outermost system points. All condensate is pumped by the customers back to the condensate receiver in the steam plant.

Steam is delivered to the buildings in the district through an extensive underground system of piping, as shown in Fig. 2, running in reinforced concrete walk-through tunnels about 7 ft by 5 ft in cross-section. Figure 8 shows the interior of a typical tunnel. These tunnels permit ready access for maintenance work under all conditions, thus insuring continuity of service. Where such continuity is of lesser importance than in hospitals, the steam is supplied through buried underground conduit, Fig. 2. Concrete tunnels run for approximately 4600 linear feet, conduit about 2200.

Tunnels run just under the sidewalks and are ventilated by gravity, having openings at various points with shafts leading up to grilles in the sidewalks. At suitable points, escape hatches and access openings are provided.

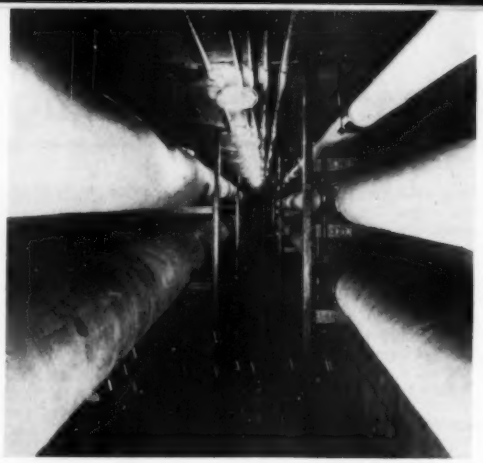


Fig. 7. View in steam distribution tunnel, looking east between Wolcott Avenue and Wood Street, showing two 12-in. main distribution headers, two 6-in. condensate returns, high-pressure trap header, and lighting system

Construction of the distribution tunnels is a separate story in itself. The district through which they run was formerly a decaying residential area. In some cases, existing buildings — old stores, delapidated flat buildings and the like — had been condemned but not yet wrecked, and were nearly falling down. If the service schedule for the steam plant was to be met, the tunnels often had to run right in front of, or alongside, such buildings. Such problems were difficult but all were solved.

The main steam distribution loop, Fig. 2, is supplied by two 12-in. main steam headers running in the tunnel and connected so either or both can feed all sections of the loop. At numerous points on the loop, the tunnel drops below normal grade and transverse pipe sleeves are provided through which other utilities are installed to buildings inside the loop. All steam and condensate piping is standard and was welded, fabricated and insulated on the job, except for the conduit piping, which is of the prefabricated type.

This new Medical Center Steam plant and distribution system were designed and constructed by Stone & Webster Engineering Corp., cooperating with the executive staff of Medical Center Steam Co., which is composed of members of Edison Co.

PRINCIPAL EQUIPMENT, MEDICAL CENTER STEAM PLANT

Medical Center Steam Company, Chicago, Illinois

STEAM GENERATING EQUIPMENT

Boilers, 3 . . . . . The Babcock & Wilcox Co.
Vertical, bent-tube 4-drum type, capacity each 90,000 lb steam per hr, designed for 200 psig, 415 F. Includes superheaters to give about 35 F superheat, and economizers; erection, setting and insulation by boiler mfr.

Stokers . . . . . The Babcock & Wilcox Co.
Chain grate type, each driven by 5 hp 440-v, 3-phase, 60-cycle, 1200-rpm motor. Each stoker equipped with Clarage overfire air fan and air aspirating steam jets

Coal Bunkers and All Structural Steel
American Bridge Co.

Non-segregating Coal Chutes . . Stock Equipment Co.

Coal-handling Equipment . . . . . Link Belt Co.
Capacity 120 ton per hr; includes Merrick Weightometer, 4 belt conveyors, crusher, tripper, driving motors, reduction gears

Platform Scale (for storage yard)
Fairbanks, Morse & Co.

Coal Scales, 4 (1 per boiler) . . . . Richardson Scale Co.
Capacity each, 15 ton per hr max.

Ash Handling Equipment . . . . United Conveyor Corp.
Standard Hydroveyor system for 3 boilers, to be extended for 4th

Gas and Oil Burners (Combination)
The Babcock & Wilcox Co.

Fuel Oil Tank, 42,000 gal. . . . . Chicago Br & Iron Co.

Fuel Oil Pumps . . . . . Worthington Pump & Mach Corp.

Fuel Oil Heaters . . . . . The Griscom-Russell Co.

Gas Metering Equipment
Roots-Connersville (by P.G.L. & C. Co.)

Forced-Draft Fans, 3
B. F. Sturtevant Div., Westinghouse Electric Corp.
Capacity each 27,200 cfm at 4 in. H_2O, 60 F, 1240 rpm

F-D Fan Drive Turbines, 3 . . Terry Steam Turbine Co.
Each 31.6 bhp, 3600 rpm max., designed for throttle steam 200 psig, 415 F, exhaust at 27 psig, driving fan through reduction gear

Induced-Draft Fans, 3 . . . Green Fuel Economizer Co.
Capacity each 46,000 cfm at 12 in. H_2O at 360 F, 910 rpm

I-D Fan Drive Turbines, 3 . . Terry Steam Turbine Co.
Capacity each 140 bhp, 3600 rpm max. designed for throttle steam 200 psig, 415 F, exhaust 27 psig, driving fan through reduction gear

Stacks, 3 . . . . . Connery Construction Co.
Steel, 12' 6" I.D. at bottom, 8' at top, 126 ft high above roof

Dust Collectors, 3 . . . . . American Blower Corp.
Capacity each 113,400 lb per hr of flue gas at 350 F. To collect 94% of total dust entering collector at dust loading of 1.5 lb per 1000 lb flue gas.

FEEDWATER SYSTEM

Zeolite Water Softener and Filter . . Cochrane Corp.
Maximum continuous net output 60 gpm for 24 hr. Emergency output 120 gpm for short periods

Phosphate & Sulphite Pumps and Equipment
Milton Roy Co. (furnished by Cochrane)

Deaerating Heater, 1 . . . . . Elliott Co.
Capacity 300,000 lb per hr, taking steam at 27 psig from aux. turb. exh. Oxygen not to exceed 0.005 cc per liter. Built-in vent condenser

Continuous Blowdown System . . . . . Cochrane Corp.

Condensate Return Tank . . . . . Buffalo Tank Corp.

Feedwater Regulators . . . . . Swartwout Co.
3 single element feedwater regulators, 1 per bhr
4 pump regulating valves, 2 on bf pump steam turbine drives, 2 on motor-driven pump discharge
1 Differential control to maintain constant differential pressure across feedwater regulators

PUMPS

Boiler Feed Pumps, 4 . . . . . Ingersoll-Rand Co.
Size 2 GT, 2-stage, 105,000 lb per hr each at 270 F, TDH 280 psig. Two pumps motor-driven by GE 75-hp 3600-rpm, 440-v, 3-phase, 60-cycle motors. Two driven by Terry steam turbines, each 60.2 bhp, 3550 rpm, 200 psig, 415 F throttle steam, exhaust 27 psig. Three pumps will feed three boilers; fourth is standby

Condensate Return Pumps, 3. Allis-Chalmers Mfg. Co.
Each 150,000 lb per hr against 160 ft hd, each driven through Thomas flexible coupling by Allis-Chalmers 20-hp, 3550-rpm, 440-v squirrel cage motor

Service Pumps, 2 . . . . . Allis-Chalmers Mfg. Co.
Each 30,000 lb per hr, 110 ft hd., driven by 5-hp Allis-Chalmers motors

Make-up, Booster, Backwash Water Pumps
Allis-Chalmers Mfg. Co.
Makeup pumps, 2; each 40,000 lb per hr, 210 ft head, driven by 10-hp motor
Service water booster pump, 1; capacity 150 gpm, 150 ft. head, 70 F, driven by 10-hp motor
Backwash pump, 1; capacity 200 gpm at 110 F, 156 ft head, 15-hp motor
Above pump motors 440-v, 3-phase, 60-cycle, 3500 rpm

INSTRUMENTS AND CONTROLS

Automatic Combustion Control
Republic Flow Meters Co.

Instruments:—Indicating and recording pressure gages and thermometers, steam flow meters, air flow meters, draft gages, smoke density meter, water columns, etc., supplied by: Bramon Dow & Co.; Brown Instrument Co.; Builders Providence Co.; Cochrane Steam Specialty Co.; Crosby Steam Gage & Valve Co.; Ellison Draft Gauge Co.; Hagan Corp.; Manning, Maxwell & Moore Co.; Minneapolis-Honeywell Regulator Co.; Reliance Gauge Co.; Republic Flow Meters Co.; Sparling Meter Co.; Swartwout Co.; Taylor Instrument Co.; The Mercoid Corporation; United States Gauge Co.; Weston Electrical Instrument Corp.; Yarnall-Waring Co.

Control Boards . . . . . The Kelek Co.

OTHER EQUIPMENT

Blowdown Tank, 5 ft by 5 ft, vertical
Makeup Tank, 7 ft dia by 8 ft long, horizontal
Service Water Tanks, 2, 8 ft dia by 8 ft long, vertical
— Buffalo Tank Corp.

Steel Pipe . . . . . L. B. Foster, Ford and Kendig

Pipe Insulation . . . . . Asbestos Asphalt Insulation, Inc.

Air Compressors, 3 . . . . . Ingersoll-Rand Co.
1—6 by 5 in.—1 stage, 41 cfm free air at 100 psig, V-belt driven by 10-hp motor. Equipped with after cooler, moisture separator and Armstrong trap. One 24 in. by 6 ft air receiver. Automatic controls for speed, pressure, unloader, water. Staynew filters, Consolidated safety valves. Furnishes combustion control air.
2—7 by 7 in., 1-stage double-acting service air compressors, each 80 cfm at 100 psig, V-belt driven by 20-hp motors. Equipped with aftercooler, moisture separator, Armstrong trap, Staynew filter Consolidated safety valves, automatic controls

Piping System
Distribution . . . . . Stone & Webster Eng. Corp.
Plant . . . . . S. J. Reynolds Co., Inc.

Test Borings . . . . . Raymond Concrete Pile Co.

Sheet Steel Piling . . . . . Carnegie-Illinois Steel Corp.

Reinforcing Steel. . . . . . Concrete Steel Co.

Underground Distribution Tunnels
Medical Center Steam Co. and Stone & Webster

Buried Underground Conduit, EBKO cast iron with wrought iron pipe . . . . . E. B. Kaiser Co.

Design, Construction and Supervision
Stone & Webster Engineering Corp.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

THE WELL-KNOWN OUNCE

It is, of course, the ounce of prevention that is worth a pound of cure. In engineering terms and especially in power engineering, it means preventive maintenance. It is not necessary to belabor the point that preventive maintenance in the utility or industrial power plant forestalls trouble before it happens. That is its purpose.

Today, with the power reserves of the country lower than they should be because of the requirements of our guns-and-butter program, the importance of minimizing power outages is greater than ever. True, the industry has not yet been "too little and too late" with power on any occasion we know of.

In the following pages you are going to read some interesting data on specific cases in which good planning and good preventive maintenance pay off. Preventive maintenance involves several factors: simplicity of design; adaptability of equipment to changes; good co-operation between equipment manufacturers and users; proper organization, planning and keeping of records. In the first of four articles on this subject, Frank L. Bradley, plant engineer of Forstmann Woolen Co., will discuss the influence of simple power plant design on preventive maintenance. Another article will show you how good planning, good tools and willing co-operation of the entire operating staff made a quick, easy job of replacing an 11-kv bus, thus forestalling future trouble from an outgrown bus system.

Instead of merely knowing how to fix things when they break down, the true engineer has always tried to anticipate trouble and remove its causes. He must concentrate more and more on that conception in the days to come.

CONTENTS

Good Planning Pays Off—11-Kv Bus Remodeled with Ease **72**
By Ray Buchan

Let Oxy-Acetylene Make Your Pipe Work Easier **74**

Simple Power Plant Design Aids Preventive Maintenance **76**
By F. L. Bradley

Practical Hints and Kinks **78**
It's the Simple Things
Sparking Brushes
Power Station Blackout
Checking Starting Winding of a Synchronous Motor
How the Mayor Stopped the Leak

Want a Kulculator Free? **80**

Basic Power Plant Figuring **81**

Questions and Answers **83**
What Causes Point on Steam Engine Indicator Diagram?
Should He Build Separate Heating Plants?

A Section of POWER ENGINEERING Devoted to

PLANT OPERATION AND MAINTENANCE

Technical Publishing Company

110 South Dearborn Street, Chicago 3, Illinois

Good Planning Pays Off— 11-Kv Bus Remodeled With Ease

By RAY BUCHAN

LOADS WERE GROWING on the 25-cycle, 11-kv Union Electric System. Consequently the company engineers found it necessary to replace the $\frac{3}{8}$- by 3-in. flat copper bus bars, at the Keokuk hydroelectric plant, with 5-in., 11-lb-per-ft copper channels. They had to keep outages to a minimum, of course, while installing 2200 ft of this copper channel in a pre-cast concrete slab compartment. Here's how they did it by careful planning of all work, provision of proper tools and — most important — outstanding cooperation of the entire working staff.

The bus compartments are shown in Fig. 2. The top three compartments contain the upper bus and the bottom three the lower bus. The new bus has flexible connectors for expansion and some fixed and some slip connections to the new bus support insulators. The old bus supports had to be removed and the old studs which were cast in the base slabs had to be cut off. It was found that about half of either upper or lower bus could be out of service at a time so the job was tackled in four sections.

Proper tools for the job were secured first. Since $\frac{3}{8}$ in. copper is easier punched than drilled, a hand operated Whitney-Jensen No. 25 punch which can handle 5 by $2\frac{3}{16}$ in. channel was bought. The flat bus-bar taps required larger holes for the new larger bolts. It was decided that they could be punched in place with less effort than to remove, do the job and replace them. A smaller punch was obtained for this job. New bolt holes in the $2\frac{1}{2}$ in. thick concrete slabs were needed so two small pneumatic drills and some carbide tipped bits were obtained. A wooden template was made for laying out the holes in the concrete slab for bus support bolts in order to be sure that the structure layout would match the fabrication of the copper. This template is shown in Fig. 3.

Several dollies were made of doubled 2 by 6's, as shown in Fig. 4, for scooting the heavy channels down the bus tunnel. Two pipe scaffolds were made up, one stationary for use in feeding the channel into the enclosure and one on casters so that it could be set at the right height and moved along the structure as assembly progressed. A sectional insulating barrier on casters, Fig. 5, was made to roll through the top compartment of the lower bus to prevent the drill from coming in contact with the hot bus below and also to serve as a wheeled dust pan to catch the drilling debris. A reciprocating power hacksaw was replaced with a metal cutting bandsaw for cutting the channel and the hundreds of splice plates. An ample supply of ratchet wrenches were secured for insulator and connection bolts. These were selected for their specific use including the ones used in the hot compartment over the insulating barrier.

Next, the work had to be organized for speed and simplicity. The layout of nearly 4000 holes of 9/16 in. diameter in the channel and spice plates was successfully done by rubber cementing paper templates on the copper and punching the holes through the paper templates and bus. This trick was successful. Every hole was in the right place and no round files were needed for fitting. The slotted $1\frac{7}{8}$ by $1\frac{1}{4}$ in. holes for slip supports were too large for hand punches, too tedious to drill and saw and too expensive to mill, so arrangements were made with the cooperative management of a local factory to punch them on their power press. A punch and die were made and in one day the entire lot of twelve tons of copper was trucked to the factory, punched and returned to the plant.

Skill and cooperation of the men made the prefabrication job run like an assembly line. Each piece of channel was piece marked with a fountain brush, cut to length, scribed down

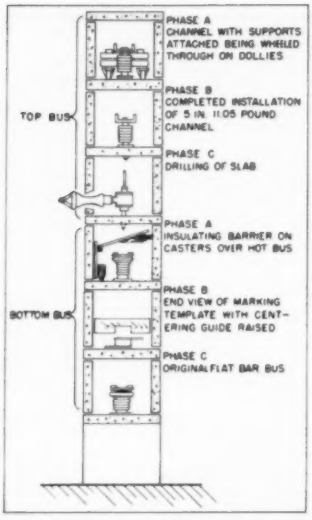

PHASE A
CHANNEL WITH SUPPORTS ATTACHED BEING WHEELED THROUGH ON DOLLIES
TOP BUS
PHASE B
COMPLETED INSTALLATION OF 5 IN. 11.05 POUND CHANNEL
PHASE C
DRILLING OF SLAB
PHASE A
INSULATING BARRIER ON CASTERS OVER HOT BUS
BOTTOM BUS
PHASE B
END VIEW OF MARKING TEMPLATE WITH CENTERING GUIDE RAISED
PHASE C
ORIGINAL FLAT BAR BUS

Fig. 1. Cross-section showing compartment construction and various phases of the remodeling job

Fig. 2. General view of the concrete slab structure in Keokuk plant

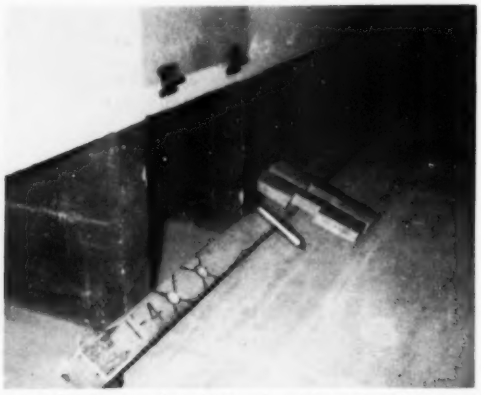


Fig. 3. Slab layout template with sleeved punch for marking hole locations

Fig. 4. Channel and insulators on dolly rolling down bus tunnel

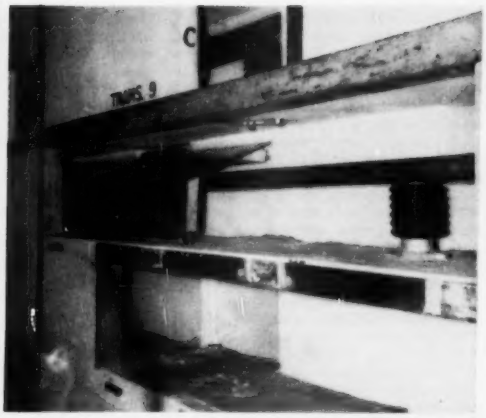


Fig. 5. Insulating barrier that was also used as a dustpan to cover hot bus

Fig. 6. The Planners—Mathews, Smith and Sykes who were the brains behind this well-planned job

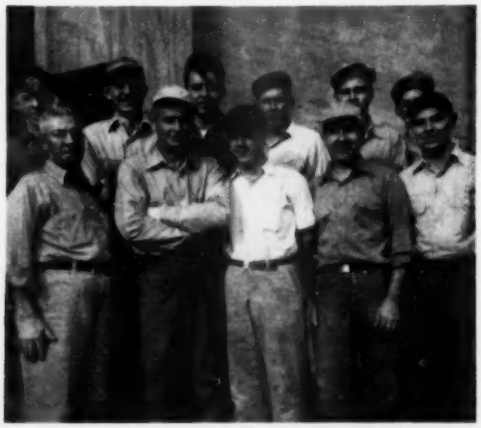


Fig. 7. The Construction Team—front (l-r) Huff, Park, Kay, Wendling, Sherrill —rear (l-r) Jobe, Meinhardt, Worrell, Tullock, Gibson, Riney

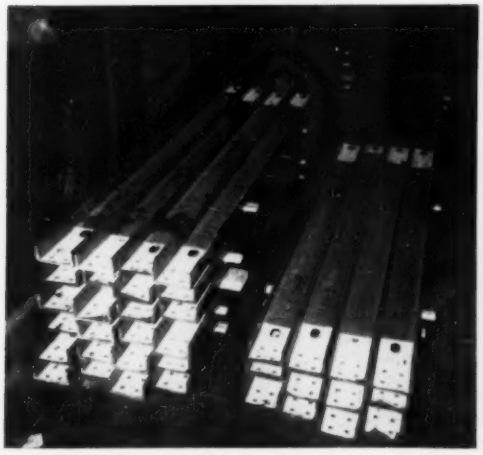


Fig. 8. Some of the prefabricated channels showing holes punched through rubber cemented in place. All holes matched paper templates perfectly

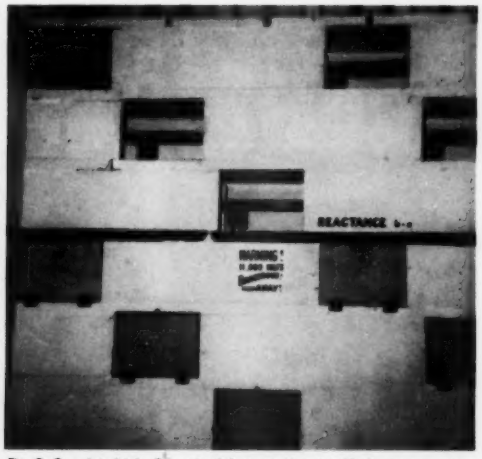


Fig. 9. Completed job. Concrete slab compartments with doors open at top showing completed buses in place

the centerline with a jigger made to fit the channel, paper templet stuck on as shown in Fig. 8, punched, cleaned and silver plated with Cool-Amp powder on the contact surfaces.

When everything was prepared, a section of bus was taken out of service, the old bus removed and the base bolts burned off. Then while the slab holes were being laid out and drilled, one side slab in each phase was removed for insertion of the long channels. Heavy angle irons which can be seen in Fig. 4 and 5 were used as supports where the slabs were removed. The bus taps were then repunched and silver plated in place. The piece-marked channels were then pushed into the tunnels, placed on the dollies and the bus supports were bolted in place. The assembly was then rolled down the tunnel to the proper place, slid off the dollies and bolted in its final place. The splice plates, pads and expansion connectors were then bolted on and all nuts were center punched to keep them from backing off. After the complete section was given a high potential test it was put in service.

The first part of the job went so rapidly that it was not long before the other three sections were completed. The entire job was finished in less than a month without any hitches. The completed job is shown in Fig. 9. It is a source of satisfaction and pride to the engineers, supervisors and workmen that a job of this magnitude, involving the hazards of personal injury from contact with high voltage plus having substantial parts of the bus out of service for days at a time worked through exactly as planned and in much less than the estimated time.

General Foreman Smith, Engineers Sykes and Mathews, who were the planners, are shown in Fig. 6. Foreman Huff and his crew of Park, Kay, Wendling, Sherrill, Jobe, Meinhardt, Worrell, Tullock, Gibson, and Riney, who did the installation, are shown in Fig. 7.

Let Oxy-Acetylene Make Your Pipe Work Easier

Use to the full this effective, convenient process. . . . The oxy-acetylene cutting, gouging and heating torches provide you many convenient ways of working with power plant piping. . . . Applications to which this portable supply of heat can be put include: cutting of ends for welding; forming pipe section into different shapes; making pipe outlets and junctions. . . . Details of cutting and gouging. . . . How to use the heating torch. . . . Cutting chromium and chrome-nickel steels. . . . Stress relieving of welds. . . . Take advantage of the 6000-F oxy-acetylene flame for bending and forming your pipe

Fig. 1. Single oxygen and acetylene cylinders, with regulators, hose and torch, mounted on a truck. One of the power plant's most useful tools

IN APPLYING the oxy-acetylene processes to pipe fabrication and maintenance and repair operations in your power plant, consider three basic processes:

1. The oxy-acetylene cutting torch;
2. The oxy-acetylene gouging torch;
3. The oxy-acetylene flame of a heating torch.

Since a majority of pipe fabrication operations are performed on ferrous materials, use of the oxy-acetylene cutting torch provides a convenient, portable means for the cutting and shaping of steel at a low cost. Essentially, the cutting of ferrous materials by the oxygen cutting process merely involves the direction of a jet of pure oxygen into an area that has been previously heated to the ignition or kindling temperature, about 1600 F, and as the iron is oxidized, slowly and uniformly moving the jet along the line to be cut. If

Fig. 2. Beveling operation on 36-in. pipe, ¾-in. wall thickness, by rotating before cutting flame

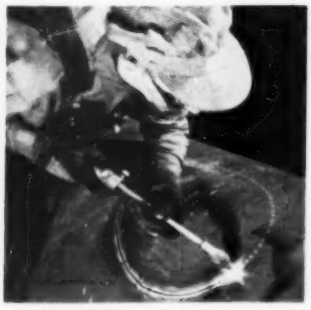


Fig. 3. How operator cuts hole manually for 14-in. outlet on 36-in. OD pipe, ¾-in. wall thickness

Fig. 4. Finished manual cut after all slag has been removed but before any other finishing operation

the cutting is to be continuous, however, it is necessary to supply heat to the metal just ahead of the oxygen stream. This required heat is called preheat.

Oxy-acetylene gouging is a rapid and economical method of forming U-shaped grooves by removing surface or edge metal. The gouging process employs a special nozzle to deliver a relatively large volume of oxygen at low jet velocity. This jet, coupled with proper preheat flame distribution, will cut a smooth, accurately defined groove in steel.

As a means of heating, the combustion of approximately equal volumes of oxygen and acetylene produces the hottest gas flame known. Temperature of the oxy-acetylene flame is estimated to be about 6000 F. Thus it is a convenient source of localized heat for a wide variety of operations in pipe fabrication, such as heating for forming and bending, for straightening, for preheating and for post heating of a welding operation.

These points were brought out by E. P. Auler, superintendent of pipe fabrication, Taylor Forge and Pipe Works, before the last annual meeting of the International Acetylene Association. He then discussed each one in detail, as follows:

How to Cut With Oxy-Acetylene

One of the common operations in oxy-acetylene cutting is preparation of pipe ends for welding. In this application, it is highly desirable to machine-cut the ends as illustrated in Fig. 2. A torch is suitably mounted on a stand and the work is revolved at a uniform rate. With the torch set at the proper angle, the pipe end can thus be cut to produce a smooth welding bevel suitable for any code welding with a minimum of cleaning after cutting.

Another important use of both manual and machine-cutting torches is the preparation of outlets on main line piping. Figure 3 illustrates the manual cutting of a 14-in. outlet on a 36-in. diameter pipe. The outline must be center-punched to give the fabricator a mark he can easily follow and the cut requires grinding to prepare the section for welding. This method is used when the time and expense of machine cutting would not warrant its use. To illustrate the machine torch cutting technique used on outlet holes, a similar outlet, Fig. 5, was cut with a machine cutting torch. A minimum of cleaning is necessary and the outlet can be fitted to the hole without too much fit-up, since the hole is a true circle cut to the proper diameter.

How to Use Oxy-Acetylene in Gouging

Use of gouging equipment has been accepted as another tool to provide better pipe fabrication. A typical operation is shown in Fig. 6. The importance of this process is that the operator has full control of the depth of the groove. At the same time, he can see when he has reached the sound metal because of the differences in color while the area is molten.

In fabrication of large-diameter piping, a majority of the joints are manually torch-cut because they are of the job shop variety and do not lend themselves to the more costly machine-cutting set-ups. It has been found that a straight cutting operation followed by tacking, and then a gouging operation, produces a welding bevel most suitable for code welding. The operator follows the square butt joints with the gouging torch, forming a groove to the desired depth for the pipe thickness. This groove is then welded and the underside again gouged to sound metal, as previously illustrated.

How to Use the Torch for Heating

One principal use of the heating torch is the preheating of materials before cutting and welding. As a result of constant increase in operating pressures and temperatures, alloy steels have been introduced to provide pipe structures that will have the necessary physical and metallurgical properties. While some of the low-alloy steels in thinner sections can be welded the same as mild steel, the heavier sections, restrained joints and certain of the alloys require preheating prior to any cutting or welding operations.

The 1951 edition of the *Code For Pressure Piping (ASA B 31.1–1951)* lists requirements for preheating carbon and carbon molybdenum steels. However, most prefabricators have, through experience, determined their requirements for alloy steels as used in fabricated pipe structures.

When the preheat temperature range is from 100 F to 400 F the heating torch is played along the welding joint in such a manner as to uniformly heat the area without too great a temperature variation. Excessive heating and too rapid heating are to be avoided. This operation is usually done manually.

For preheat temperatures ranging from 400 F to 900 F, it is often necessary to accurately measure the temperature before and during any welding or cutting operation. This can best be done with surface pyrometers or with special waxes manufactured to melt at a given temperature. The heating torch is then used as often as is necessary during the operation to bring the temperature to the desired point. Fabricators are finding the heating torch more and more a means of solving tough welding problems by providing preheat.

In the welding of fabricated piping, a certain amount of distortion occurs. This is because the structures are relatively thin and thus are not restrained. Although supports and struts are applied to prevent distortion it is often necessary to perform a straightening operation. Because of the close tolerances of fabricated piping, this can best be done with a heating torch.

The torch is used to rapidly heat a small band to a plastic temperature and since the surrounding is cold, the plastic metal upsets slightly. As the entire section cools, this upset area pulls, causing a change in the shape of the section. Generally, several small bands are better than a few large ones. In this manner, main run pipe ends can be rounded up when a header has been welded near the end.

Third important use of the torch is in the heating of sections for forming operations. With the heating torch, areas of about 6 in. in diameter

Fig. 5. Bevel cut made by machine, with slag cleaned from it, ready for assembly of an outlet

Fig. 6. Operator prepares a welding groove by gouging, on 4–6 per cent chrome-molybdenum

Fig. 7. Large torch preheating welding groove, on 4–6 per cent chrome-molybdenum to 600–900 F

can be heated to approximately 1700–1800 F and the area deformed to fit the required contour by a hand-forming operation.

Special Applications

High-chromium and chromium-nickel alloys can be successfully torch cut by use of special equipment and a powder of fluxing material to remove the oxides of the alloying elements, which prevent the oxygen stream from reaching the iron and allowing the cutting to proceed. The cut thus made must be ground before any further operations are performed on the piece. This method is applicable to any thickness.

Another special application is stack cutting. This method offers a means of cutting a number of plates simultaneously with a single torch or with multiple torches, by stacking the plates and securely clamping them to form a thickness of 3 to 4 in. It is used when identical shapes must be cut from plate in large quantities.

Cutting of material less than 3/16 in. thick requires techniques entirely different from those previously described. Basically, clean square cuts can be made at relatively high speeds if a leading angle is applied to the torch nozzle and proper tips are used with accurate control of the cutting oxygen pressure and the size and type of preheat flame.

Another unusual application of the oxy-acetylene heating torch is the low-temperature stress relieving of welds. Two multiflame torches are moved along on either side of the weld to be stress relieved, followed by a spray of coolant water. By moving the assembly at a speed relative to the thickness, this application of heating and cooling in effect plastically deforms the weld — thus mechanically stress-relieving the weld area.

Oxy-acetylene equipment must be used with proper engineering control and the operators must have a good working knowledge of the equipment in order that the greatest value be derived from the processes. Since the mixture of oxygen and acetylene is explosive, rigid safety rules must be adhered to and all required safety precautions taken. Poor quality work is generally the fault of misused equipment or lack of operating know-how — not processes themselves.

Simple Power Plant Design Aids Preventive Maintenance

By F. L. BRADLEY
Plant Engineer
Forstmann Woolen Co.

Preventive maintenance is now as important for proper operation of a power station as any other operation in it. . . . No longer do you hire men just to fix things. . . . You have a regular program to inspect equipment at definite time intervals and make any necessary repairs before breakdowns occur. . . . Also, you have trained men and equipment to do the job. . . . This is the first of four articles, which will show you how simple plant design, equipment adaptability, maker and user co-operation, and proper operating practices will all aid preventive maintenance and keep operating costs at a minimum

IMPORTANCE of maintenance and its place in the operation and management of a power plant has risen from a humble beginning to one of major magnitude. Substitution of machinery for manual labor has increased the maintenance problems where these substitutions have been made. The boiler room of the past had an army of coal wheelers, water tenders and ash handlers, who have now been supplanted by machinery. With this development, the power plant has taken upon itself its full share of maintenance problems.

A Key Service

Vital importance of power plant availability to production places it in the role of a *key* service. This is especially true of the isolated power plant generating all the services required for production. Electricity for light and power, steam for process purposes or building heating and air conditioning, compressed air for machine loading and instrument control, and soft water — all are services vital to industrial production. All depend on continuous operation in the power house. We are all very dependent on the power house, whether it be the isolated plant or the central station. The storm along the east coast in November 1950 proved this very convincingly. Candles substituted for electric lights — but there was no substitute for the electrically-driven oil burners. Low temperatures and shivering were prevalent in too many homes.

Much has been said and is still being said about the value of preventive maintenance. If the power plant is to supply the services that are the very life blood of production operations, then preventive maintenance is a *must* to insure continuity of its supply. This was discussed in detail by the author in a paper before a recent Plant Maintenance Conference.

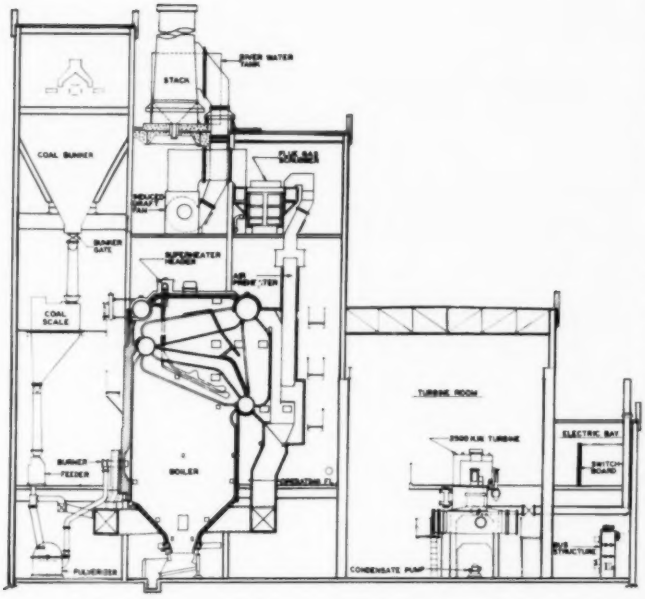
Preventive maintenance, at least in its primitive form, made its appearance early in the power plant. Water treatment to prevent hard scale deposits and caustic embrittlement in boilers was one of the first steps to avoid boiler shutdowns, and even explosions. The insurance inspector's detailed checks on the governor valve and fly wheel of the steam engine were necessary to prevent the *runaway* engine with its disastrous results. *Reliability* checks of the overspeed governor, and the periodic lifting of the steam turbine casing — each is a recognized *must* in the present-day power plant. These measures were considered to be routine operating steps in the old days. Today we classify them under the category of preventive maintenance.

A definition of preventive maintenance as applied to power house operations is: — anticipation and prevention of performance deficiencies and major repairs through design, operation, inspection, lubrication, planning and follow-up.

Equipment Upkeep Compared to Repair

Upkeep in power equipment is of far greater influence on output and economy than it is in many manufacturing enterprises. Emphasis on upkeep is on reduction of major breakdowns just as vaccination is in prevention of smallpox.

Cardinal difference between the aims of upkeep and repair is that upkeep of the plant tends to keep up the efficiency of equipment and plant in its original state. Repair mends or replaces the wornout or broken parts. Thus, repair is concerned with maintaining the original form of the plant and equipment, while upkeep aims at preservation of its original efficiency. Therefore,



Cross-section through an industrial power plant designed for simplicity, one of most desirable factors leading to low power plant maintenance

any power house preventive maintenance program should stress first upkeep and second reduction of major repairs.

Proper Design

One of the most positive and profitable approaches to preventive maintenance is through proper design. Operation of a plant or equipment burdened with poor design characteristics must always face an uphill maintenance fight. Unless that design is adaptable to change or correction, maximum efficiency is only a mirage and repair is the order of the day.

High steam pressures and other advances have given us much to brag about in our performance figures. This development in the art of generating steam and power was acquired at a sacrifice in simplicity. It has brought increased maintenance in practically every piece of equipment. An example is the boiler feedwater system through the steam generator and the entire steam distribution system up to and including the prime mover. Consideration of these increased sources of maintenance is ample proof of the desirability of simplicity in design as an initial and effective attack on the maintenance problems of a power plant as a unit.

Plant Simplicity

The layout shown in the accompanying drawing is typical of a plant designed with emphasis on simplicity. All the equipment included is essentially necessary for generation of steam and power.

Coal, the principal fuel, is fed by gravity to a pulverizer for preparation and delivery to the burner. The coal scale for cost control and the coal feeder for combustion control are the only additional pieces of equipment in the fuel system. Water-cooled furnaces, with only the essentials in firebrick, reduce refractory replacements to a minimum. Fly ash removal equipment protects the induced-draft fans and prevents a fly ash nuisance problem in the community of which the power house is a part.

Modern Boilers

The bent-tube boiler with its favorable water circulation and welded drums enjoys basic protection against tube leakage and embrittlement troubles. Application of protective coatings to all wetted surfaces, together with supervised water treatment, may eliminate or reduce corrosion within the boiler to a minimum. A deaerator for heating the feedwater and delivering it to the boilers free of oxygen, spares the operator from internal corrosion. The modern equipment for power and extraction steam production does not present any serious maintenance difficulties.

Constant improvement in power plant apparatus is eloquent evidence of the manufacturer's contribution to the battle for equipment upkeep and reduction of major repair. Replacement of the hrt boiler by the water-tube unit has provided a safer and more flexible unit. Design of the latter features not only accessibility in making inspections and routine repairs, but effective means of maintaining capacity and efficiency through adequate servicing and cleaning.

Wider Range of Coals Can Be Burned

The unit pulverizer has contributed greatly to the art of burning a wide range of coals. Properly relayed with other pulverizer units, its accessibility permits repair without unfavorable effect on the availability of the boiler it serves. Wear of parts, definitely impairing capacity, has been the principal trouble encountered. One manufacturer is offering wearing parts with tungsten carbide surfaces to extend their wearing life. It is claimed this improvement will extend the life of these parts several times.

The stoker, which originally replaced the human coal shoveler, has experienced developments conducive to improved upkeep and repair. The modern stoker, from crude beginnings with only a few basic control rods and levers, has become a piece of precision equipment (aside from its lack of accessibility for emergency repairs). Its application is increasing in the industrial fields.

Those who have stoker installations should be interested in a recent development that contributes greatly to decreasing boiler maintenance. The Detroit Edison Co. has been doing work on the reduction of fireside deposits. In a paper presented before the ASME (see POWER ENGINEERING, June 1951, page 92), Messrs. Murphy, Piper and Schmansky state that increasing the humidity of combustion air to at least 16 lb of water per 1000 lb of dry air has been found to greatly reduce fireside deposit troubles in stoker-fired steam generators at the Delray Plant of The Detroit Edison Co. By keeping the heating surfaces cleaner than normal, this humidification will improve average boiler efficiency sufficiently to compensate thermally for the water added to the combustion air, leaving a pronounced gain in availability and lower maintenance. Humidification appears to decrease volatilization from the fuel bed, particularly of silicon compounds.

Specific Examples

The foregoing general comments on upkeep and the influence of simplicity in design cover the general principles. Future articles will show how these are applied in specific examples, such as adaptability of a water softener to changes, effect of co-operation between maker and user of a flue gas scrubber, and how a properly trained staff can cut upkeep to the bone and forestall trouble by using a well-planned maintenance schedule.

PRACTICAL HINTS AND KINKS

IT'S THE SIMPLE THINGS

THE LIFE OF THE maintenance man is full of troubles and anything that will make his path a little smoother should be a welcome addition to his setup. One of the things he has to contend with is the moving of motors for various reasons. When these items are above two horsepower, weight becomes a factor in handling. Many motors are equipped with an eye-bolt or a tapped hole for the insertion of it. However, in too many cases, the bolt becomes lost and the proper size is not available when needed.

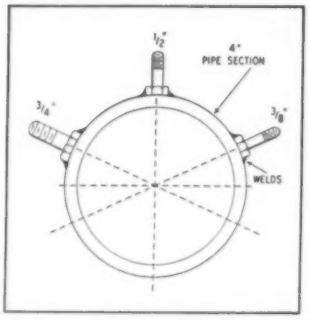


Fig. 1. Example of lifting ring with assorted studs

A simple device that will assure the availability of the proper size bolt is shown in Fig. 1. The ring can be made from a piece of four inch pipe and the bolts, selected to meet the existing conditions, are welded to the ring at such points that they will not interfere with each other or with the chain or sling of the hoist. If this device is kept with the hoist or close to it, much time and back strain will be saved to say nothing of damage that might be caused by improper slinging of the motor.

—Westinghouse Maintenance News

SPARKING BRUSHES

By THOMAS TRAIL

SEVERAL YEARS AGO, a large hotel converted from direct- to alternating-current. In the process, eight 45 hp m-g sets were installed in the elevator machine room to power eight variable-voltage elevators.

Approximately a year later, the brushes in one of the generators required replacement. Brushes bearing the same manufacturer's number were installed and the machine was returned to service. In a few weeks, commutation difficulties arose. The brushes began to spark under load and proceeded to become progressively worse. In addition, the brushes began to chatter.

Various remedies were tried. Brush holder pressure was increased in the belief that the brushes were operating under insufficient contact pressure. This failed to improve matters. The commutator was stoned and the brushes were seated again with a brush seater stone. However, no favorable results were obtained. Conditions actually became worse and when three of the dozen brushes split through the center, it was decided to resurface the commutator. This was done and the segment edges beveled. The commutator surface was polished until it shown like a mirror.

New brushes, duplicates of those removed, were carefully fitted and seated and the machine was restored to service. Commutation appeared highly satisfactory and it seemed the difficulties were at an end.

Within 24 hours sparking became noticeable. With the thought that burnishing might help relieve sparking until a film had developed on the commutator surface, a maple block was used to impart a chocolate color to the commutator. This seemed to reduce the sparking.

But within a matter of hours, the sparking again began to increase. The local representative of the manufacturer of the machine was contacted. After noting conditions, he stated that his company had once before experienced a similar commutation difficulty after the installation of the same type of brushes. The brushes might be the source of the trouble because of some variation in their composition. It was thus decided as a test, to install a new set of these same brushes on another of the m-g sets. A set that had been exhibiting exceptionally good commutation.

This was done and within a day or two this second machine began to show symptoms of commutation distress. Then it was concluded that something was definitely wrong with the brush composition. The manufacturer replaced all of this type of brush in the hotel's replacement stock, plus those on the machine with the same style and grade but of a different lot.

The new brushes were installed and sparking and noise disappeared. From this experience, it appears evident that despite all indications that a particular brush is a duplicate of another, it is possible, nevertheless, for the composition to be sufficiently different as to render the brush totally unfit for the particular application for which it is intended.

POWER STATION BLACKOUT

By WILLIAM SHEFFER

SOMETIME, during the life of an operating engineer, he will experience a total blackout in his power station. This will be caused probably by a lack of steam, or a failure of a generating unit or an outside line failure or some other electrical or mechanical fault. When this happens, he will be faced with the problem of re-starting as quickly and safely as possible. To make the job difficult, he will be bothered by advice from know-it-alls and phone calls asking what the trouble is.

Let us assume that we have a plant operating normally. There are two a-c units feeding the bus. The exciters for these units are in parallel. Voltage regulators serve all exciters. There is a spare generating unit of the same capacity as the two on the line with the same equipment. The plant supplies ten outside feeders as well as the house feeder. The plant is operating at two-thirds load and everything is serene. The operator is drinking coffee and taking life easy.

Suddenly, No. 5 circuit breaker trips due to a bad fault in the cable vault at the foundry. The breaker, since it hasn't been serviced properly, takes its own time tripping-out. Load on the units due to the low reactance of the alternators and no reactive protection jumps to five or six times rated current at full load. The units groan mightily and the frequency drops at an alarming rate.

The operator heads for the board. However, there isn't much he can do at this point. With the terrific load thrown off the units by the tripped breaker, the machines overspeed. While rated at six per cent regulation, and the overspeed device supposed to be set at ten per cent overspeed, things are not what they seem to be. Speed hits 110 to 112 per cent, the units trip, and there is an appalling silence, broken only by the hissing of a few neglected steam leaks. Then the silence is shattered by the phone bell and finally by the pop valves on the boilers. In this plant there is no boiler control. The operator properly ignores the phone and takes steps to get his house circuit alive again.

He trips all feeder breakers, generator breakers, and pulls all field and exciter switches. The voltage regulator is put in the hand control position and all the main field rheostats as well as the exciter field rheostats are cut in. He now has a completely neutral board.

Now he closes the throttle valves on the prime movers and resets the overspeed devices. Selecting one of the units, he opens the throttle, starts the unit, and brings it up to speed or nearly so depending on sound. Next he closes the voltage regulator control switch and brings

the exciter voltage up to a value he knows from experience will be sufficient to excite the main unit to bus voltage. The exciter bus is then energized, the main field switch is closed, and the alternator voltage is brought up to its operating value. The main breaker is now closed energizing the main bus. Next he regulates the machine speed with the throttle, watching the frequency meter, until the proper operating frequency is obtained. When this is done, the main field rheostat is cut out and the voltage is regulated by means of the exciter field rheostat. The house breaker is closed and he is back in business again. The unit may slow down from the house load but this is quickly rectified by hand throttle control to speed it back up.

Of the nine operable feeder circuits, some are of more importance than others. One by one, each feeder is energized and after closing each breaker, the machine speed is normalized by throttle control. When the machine capacity is nearly reached, the second unit is put on the bus.

When this second unit shut down, the governor spring was adjusted at two-thirds load. Before he starts this unit, he decides it is best to release the compression on this spring so that the unit will not overspeed on starting. A hand tachometer can be used to check the speed of the unit if there is no tachometer on the machine. Another thing that can be done is to excite the alternator and use the synchroscope. He remembers that the synchroscope will merely vibrate if the speed of the running machine and the one being started are too far apart. When the correct frequency is attained, the machine is synchronized in the usual manner and the balance of the load is picked up.

There is another method of picking up the load. The first machine is brought up to speed by throttle, excited and connected to the bus. Then, watching the frequency meter, the throttle is gradually opened and the governor spring is run down, so that the desired frequency is maintained. Then each breaker is closed and speed picked up by means of governor control. This method has the disadvantage in the case of heavily loaded feeders, cutting in the heavy load may cause extreme hunting of the units, even causing the overspeed to trip again. This is especially true when the governors are not operating properly. Which method to use is up to the judgment of the operator.

CHECKING STARTING WINDING OF A SYNCHRONOUS MOTOR

RECENTLY, difficulty developed in starting a synchronous motor driving an air compressor. The mechanical condition, unloading and control devices, field and stator winding were checked. When nothing was found wrong, suspicion finally fell on the starting or amortisseur winding. Inspection did not reveal anything wrong here either.

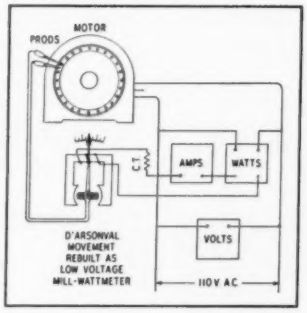


Fig. 1. Diagram showing how to make bar-to-ring test on starting winding of synchronous motor

A low voltage single-phase impedance check of the stator, measuring voltage, amperage and watts with the rotor in several positions was made. Comparison with a duplicate motor showed a higher impedance and different power factor.

The reason for this difference was attributed to poor contact between the amortisseur bars and their end rings. The bars had merely been expanded into holes in the end rings. Mechanically, however, these bars seemed to be tight in the rings.

In order to more fully investigate the matter, individual bar-to-ring joints were tested electrically in the following manner.

A low voltage wattmeter was devised from an old D'arsonval movement d-c meter. A laminated field was substituted for the permanent magnet. This field was excited from current (with appropriate current transformer) used to make the stator impedance test. The moving coil of the meter was connected to a pair of sharp steel prods and prodded directly across the joint to be tested and which was carrying induced rotor current during the impedance check. While, strictly speaking, it would be necessary to consider phase angle, good joints showed practically no reading while faulty joints gave an unmistakable indication. Joints which showed no reading were retested with rotor shifted approximately 90 degrees to make sure they did not happen to be in a position of no induced current.

In this way it was a comparatively easy job to re-expand the faulty joints until the test showed no reading for all joints. An over-all impedance check then showed the value to be in line with the duplicate motor and when put back in service starting was again normal.

This same test procedure would be very useful in determining the condition of any squirrel cage induction motor. In this connection it would be desirable to have on hand factory test data of impedance (preferably single-phase) of all important motors.

—Westinghouse Maintenance News

HOW THE MAYOR STOPPED THE LEAK

By H. D. McDERMID

A SMALL municipal pumping station was equipped with two identical triplex piston pumps. Each was driven by a large induction motor through a heavy gear train. The pumps were built for heavy duty. Their daily service period was short — usually amounting to about one hour's pumping against a 185 psig head into a large water tank high on the hill above the plant. This reserve was carried for possible fire protection. The usual procedure was for the pump operator to refill the tanks each morning and then go about his private affairs the rest of the day. However, he always kept within call in case of a fire or other emergency. This led to rather careless handling of some of the small chores about the plant.

"Enter the Villain"

One morning the mayor made an unannounced inspection trip and found the pumproom deserted. He noticed that the discharge valve stem of one of the pumps which cuts it off from the city mains was leaking slightly and there was a puddle on the floor. Both pumps were shut down. The little leak vexed hiz-zonner very much. So, he decided to stop the leak by closing the discharge valve. This stopped the leak and also cut off the pump from the mains. It also relieved the pump discharge valve chambers of all pressure — as long as the pump remained idle.

The pump operator had formed the habit of simply tripping the two-step starter on the pump motor when the pumping was done and leaving everything else "as is". Thus, all he had to do when starting up was to flip the switch of his starter and the pump was on-the-line.

"Cometh the Hero"

A moment after the mayor had done what he considered his duty, the operator came in — saw he had company, and being a little late, merely nodded to the mayor. He stepped over to the motor starter and threw in the big motor, serene in his experience of hundreds of apparently exactly similar starts.

Before either of the witnesses could sense anything was wrong, and correct the trouble, the weakest spot was found and relieved itself of the tremendous load. The entire top of the rather large discharge valve chamber blew off. Both men were badly scared and both were equally perplexed although neither was injured. The operator claimed he could not figure out what had happened. Examination of the totally wrecked pump revealed the closed valve.

Want a Kulculator—FREE?

By **WILLIAM J. FADDEN, Jr.**

The Kuljian Corporation

To get one of these Kulculators FREE, write the Editor, Power Engineering, 110 South Dearborn St., Chicago 3, Ill. Please give your position and company connection. For convenience, you may want to use the postage-free card, page 37.

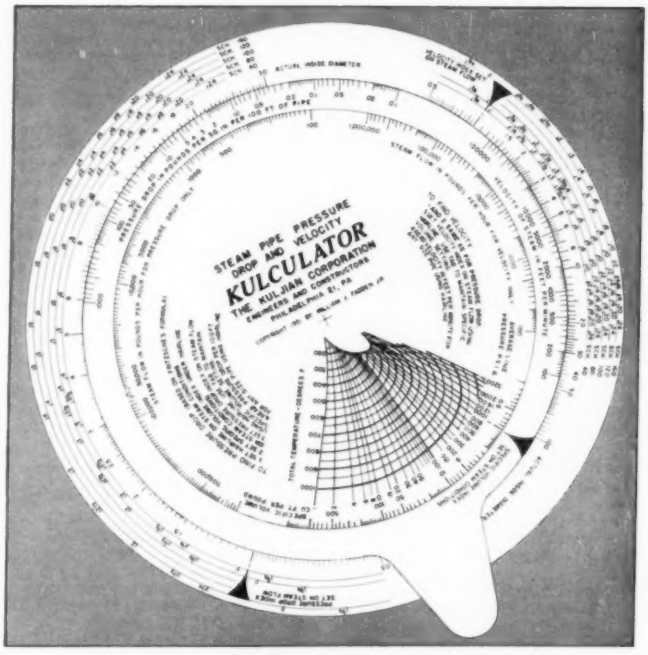
HERE'S a handy calculator for making quick estimates of steam-pressure drops and velocities in standard piping.

The Kulculator consists of three separate discs and a revolving arm. It can be observed from the small disk that the representation of the steam conditions is an enthalpy vs. specific volume chart. Pressure and temperature curves permit quick setting of the revolving arm, which rotates about the center of the chart and is used as a hairline. The middle disk is rotated until the specific volume index lines up with the hairline. This setting is then maintained until the steam conditions change.

To find the steam-pressure drop for any standard size pipe, set the pressure drop index on the given steam flow by rotating the large disk. Then read the pressure drop per 100 ft of pipe, on the middle disk. Use the hairline for greater accuracy and ease.

To find the velocity for any standard size pipe, set the velocity index on the given steam flow by rotating the large disk. Then read the velocity in feet per minute on the middle disk for any standard size pipe. Again use the hairline for accuracy.

When solved directly by the formula, the pressure drop equals 11.23 psi per 100 ft of pipe and the velocity equals 8878.2 ft per min.



This is the Kulculator, on which you can quickly read pressure drop in piping. Actual diameter 6¾ in.

Example: With steam at 900 psia, 900 F., and 50,000 lb per hr flowing in a 4 in. Schedule 80 pipe, find pressure drop per 100 ft and velocity.

Solution: Set hairline at intersection of 900 F. and 900 psia (Read enthalpy = 1451 Btu per lb, specific volume = 0.85 cu ft per lb). Set specific volume index under hairline. Set pressure drop index on 50,000 lb per hr steam flow.

Read pressure drop, using hairline, for 4 in. Schedule 80 pipe = 11.1.

Set velocity index on 50,000 lb per hr steam flow. Read velocity, using hairline, for 4 in. Schedule 80 pipe = 8800 ft per min.

Fritzsche's formula has been found to give more accurate results than most of the other empirical formulas, for the pressure drop in steam pipes for sizes 10 in. and larger carrying steam of high velocity. Most engineers prefer to use charts at least as first approximations in sizing steamlines. It is suggested, however, that the rational method be used whenever it is essential to have a more reliable prediction of the pressure drop. Regardless of which method is used the values for specific volume should correspond to the average pressure if the drop exceeds 10 per cent of the initial absolute pressure.

Fritzsche's formula:

$$P = \frac{0.8LF^{1.8}}{Y\,d^{4.8}} = \frac{2.1082 \times \text{Spec. Vol.} \times L \times W^{1.8}}{10^5 \times d^{4.8}}$$

Where: F = steam flow, lb per sec
W = steam flow, lb per hr
P = pressure drop, psi
L = equivalent length of straight pipe, feet
Y = average density of steam, lb per cu ft
d = actual inside diameter of pipe, inches

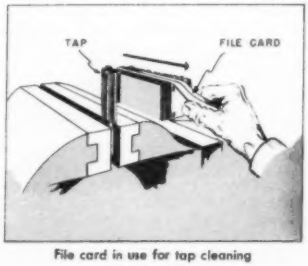
RADIO INTERFERENCE

By W. E. WARNER

ELECTRIC POWER plants often cause interference with radio and similar sets. This is often due to the electrical plant being in a bad condition. Suppressors are not always fully effective. One cause of this with motors and generators is the armature running out of true causing vibrating brushes or brushes being a slack fit in their holders. These troubles can be overcome by covering the insides of the brush holders with flake graphite. This will serve to lubricate the brushes and take up any clearance. Another cause is high resistance or bad earthing connections. The resistance of the earth wires and connections should be frequently tested and should not exceed 2 ohms from any point to main earth.

FILE CARD

The wire brush side of a file card may be used to clean taps and small drills, as shown, by dipping it in varsol or similar solvent and brushing loose the chips and metal dust.



File card in use for tap cleaning

Basic Power Plant Figuring

By **WILLIAM H. ENGELMAN**
Mechanical Engineer
Cleveland, Ohio

All re-publication rights reserved by author

How to Figure Work, Horsepower, Moments, Torque

UNDERSTANDING of machinery requires knowledge of the principle of work, which is FORCE × DISTANCE. With a good background of arithmetic, you can solve almost all work problems comparatively easily and quickly.

Work is performed when a force acts on a body. The rate of doing work depends upon force, distance and time. The force may be given in pounds, tons, kilograms, or any other unit of weight. The distance travelled may be in feet, miles, centimeter, kilometers, or any other unit of length. The time may be expressed in seconds, minutes, hours. Power is the rate of doing work. One horsepower (hp) equals 550 ft-lb per sec, 33,000 ft-lb per min or 1,980,000 ft-lb per hr, (33,000 × 60).

Work and Horsepower Defined

Unit of work is the foot-pound and is defined as the amount of work to overcome a resistance of 1 lb through a distance of 1 ft or to raise 1 lb a vertical distance of 1 ft. It does not matter whether the 1-lb force is applied vertically, horizontally or in a circular path through a distance of 1 ft, the work done is 1 ft-lb.

There is a simple, yet many times misunderstood, relationship between the various terms used in power calculations. Work done is the product of the moving force and the distance traversed. Thus if it takes a force of 20 lb to pull a sled a distance of 10 ft, as shown in Fig. 1, the work done is 20 × 10 or 200 ft-lb.

A crane, Fig. 2, lifts a load of 10,000 lb a vertical distance of 20 ft in 1 min; here's how to calculate the work done and the rate of doing work. Here the force is 10,000 lb, the distance 20 ft and the time 1 min. Work done is 10,000 × 20 or 200,000 ft-lb in one minute and the horsepower required is 200,000 ÷ 33,000 or 6.06 hp.

An automobile, Fig. 3, weighing 3500 lb moves at the rate of 60 mph under a constant force of 300 lb, what is the required horsepower?

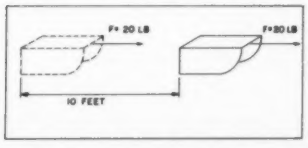


Fig. 1. Work done in pulling sled is force to pull times distance pulled = 20 x 10 = 200 ft-lb

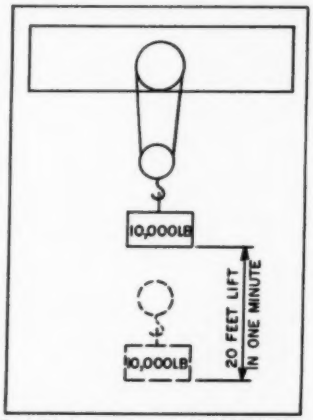


Fig. 2. Work done by crane to lift 10,000 lb 20 ft in 1 min = 20 x 10,000 = 200,000 ft-lb per min

Here the force F is 300 lb, the distance 1 mile per min or 5280 ft, therefore the horsepower is (300 × 5280) ÷ 33,000 = 48.0.

NOTE: The weight of the automobile does not enter into this problem, for it is not the force that produces the motion.

A pump raises 6000 gal of water in an hour to a height of 200 ft; what is the theoretical hp? Then 6000 gph equals 100 gpm; the weight of a gallon of water is 8.34 lb. Hence the force is equivalent to 100 × 8.34 or 834 lb. Vertical distance is 200 ft, through which the water must be raised in one minute.

With a 1-min time unit, the horse power is (834 × 200) ÷ 33,000 = 5.05

With a time unit of 1 hr the horsepower is (60 × 100 × 8.34 × 200) ÷ 1,980,000 = 5.05

The elevator in an office building.

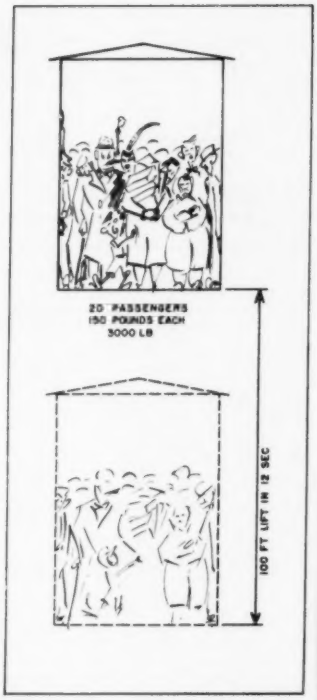


Fig. 4. This elevator, carrying 20 passengers weighing 150 lb each, requires 45.5 hp to raise it 100 ft in 12 sec

Fig. 4, carries 20 passengers weighing 150 lb each to a height of 100 ft in 12 sec. What is the total work done, the work done per second, and the required horsepower?

Load is 20 × 150 or 3000 lb and the distance moved 100 ft.

Total work done is 3000 × 100 or 300,000 ft-lb in 12 sec.

Work done per second is 300,000 ÷ 12 equals 25,000 ft-lb.

Required hp is 25,000 ÷ 550 = 45.5 (550 ft-lb per sec = 1 hp)

What Does Torque Mean?

Twisting moment or TORQUE is that force which produces rotation in a shaft, drum or pulley.

Let: P = Load or weight in pounds to be moved.

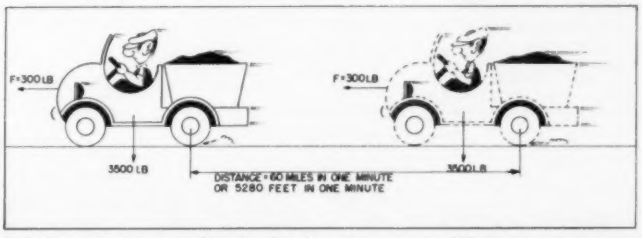


Fig. 3. If an automobile travels 60 mph and the force that propels it is 300 lb horizontally, it requires 48 hp. Weight of the car has nothing to do with it

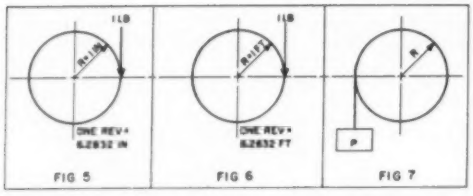


Fig. 5, 6 and 7. Diagrams showing measuring of torque or twisting

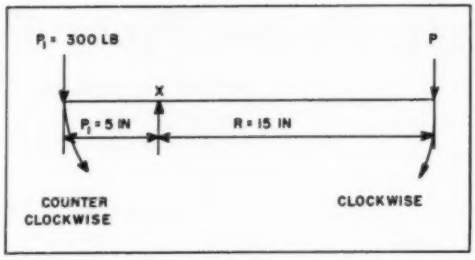


Fig. 8. (Right) Diagram showing how moments of 2 forces are taken about point X

π (pi) = 3.1416, the circumference of a circle with a diameter of 1.
R = Radius of drum or pulley in inches or feet.
$2 \pi R$ = Circumference
N = Revolutions per minute, rpm
T = Twisting moment or torque in lb-in., when R is in inches.
T = Twisting moment or torque in lb-ft, when R is in feet.
W = Work done.
Hp = Horsepower = 33,000 ft-lb per min, 1,980,000 ft-lb per hr, or 550 ft-lb per sec.

Then the torque is the product of the force P times the length of the lever arm R, hence $T = P \times R$. The work done is the product of the moving force and the distance traversed $W = F \times D$. The distance through which the force acts in one revolution is the circumference or 6.2832 R. See Figs. 6, 7 and 8.

Then: $W = P \times D = 6.2832 \times R \times P$ lb-in.

In making N revolutions the total work is

$W = 2 \times \pi \times R \times P \times N$ or $6.2832 \times R \times P \times N$ lb-in.

Horsepower required when making N revolutions per minute is

$$Hp = \frac{2 \times \pi \times R \times P \times N}{33{,}000 \times 12} = \frac{6.2832 \times R \times P \times N}{396{,}000} = \frac{R \times P \times N}{63{,}025} = \frac{T \times N}{63{,}025}$$

$$T = \frac{63{,}025 \times Hp}{N}; \quad P = \frac{T}{R}; \quad R = \frac{T}{P};$$

$$T = P \times R$$

By substituting values in the above formulas, any necessary item can easily be found.

Using lb-in, $(33{,}000 \times 12) \div 6.2832 = 63{,}025$, a constant.

Using lb-ft, $33{,}000 \div 6.2832 = 5252$, a constant.

Practical applications of these constants will be given in numerous problems showing all the calculations required.

How to Figure Moments

First, however, you must understand what we mean by moments. A fundamental law of mechanics states that for a body to be at rest the sum of all the moments acting on that body must be equal to zero. More simply, the clockwise moments must equal the counter-clockwise moments. In Fig. 8, the 300-lb force acts in a counter-clockwise direction with a moment of 300×5 or 1500 in.-lb. The unknown force $P \times 15$ must be equal to 1500 or $P = 1500 \div 15 = 100$ lb.

Mathematically: $P \times R = P_1 \times R_1$.

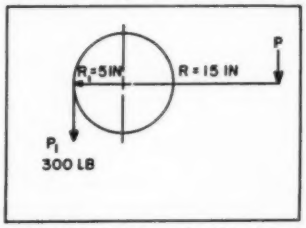


Fig. 9 Principle of windlass with a 10-in. diameter drum and a 15-in. crank

An equivalent of the above is the diagram, Fig. 9, of a windlass with a 15-in. crank and a 10-in. diameter drum. Again the 300-lb weight acts in a counter-clockwise rotation with a radius of R_1 of 5 in. and the force P with a lever arm R of 15 in. in a clockwise direction. Here we have:

$$P \times R = P_1 \times R_1$$

$$P = \frac{P_1 \times R_1}{R}$$

$$\text{or } P = \frac{300 \times 5}{16} = 100 \text{ lb}$$

How to Apply These Principles for Solving Torque Problems

1. A load of 1000 lb is hoisted with a 24-in diameter drum. What is the torque necessary to move it? (Neglect starting and operating friction)

$T = P \times R = 1000 \times 12 = 12{,}000$ lb-in. torque
$1000 \times 1 = 1000$ lb-ft torque

2. In problem 1, how much work will be done in one revolution?
$W = P \times 6.2832 \times R = 1000 \times 6.2832 \times 12 = 75{,}400$ in.-lb

3. How many horsepower will be required to drive this drum at 75 rpm?

$$Hp = \frac{P \times 2 \times \pi \times R \times N}{33{,}000 \times 12} = \frac{1000 \times 6.2832 \times 12 \times 75}{396{,}000} = 14.28$$

Applying the constants to this problem with the radius R given in inches or feet:

$$Hp = \frac{R \times P \times N}{63{,}025} = \frac{12 \times 1000 \times 75}{63{,}025} = 14.28 \text{ hp}$$

$$Hp = \frac{R \times P \times N}{5252} = \frac{1 \times 1000 \times 75}{5252} = 14.28$$

4. If it requires 14.28 hp to drive the drum at 75 rpm what is the torque in inch-pounds at center of shaft?

$$T = \frac{63{,}025 \times hp}{N} = \frac{63{,}025 \times 14.28}{75} = 12{,}000 \text{ lb-in.}$$

5. What is the load in pounds on the 24-in. diameter drum if the torque is 12,000 in-lb? (Standing load, drum is not turning)

$$P = \frac{T}{R} = \frac{12{,}000}{12} = 1000 \text{ lb}$$

6. With the known torque of 12,000 in.-lb and a drum load of 1000 lb, what is the radius of the drum in inches?

$$R = \frac{T}{P} = \frac{12{,}000}{1000} = 12 \text{ in. radius or 24 in. diameter.}$$

How to Figure Belt Drives

Belt drives are easily analyzed in much the same manner as the previous problems. The force in pounds is the net pull on the belt. The distance in feet per minute is the diameter $\times 3.1416 \times$ the rpm. The time is 1 min, since the revolutions are usually given per minute.

With a pulley standing still, the belt is subjected to a pull called the

Initial tension. To move the belt requires a force called *Total* tension. The total tension minus the initial tension is called the *Effective tension;* it is the net pull on the belt. See Fig. 10.

In the diagram of Fig. 10:

Total tension is 300 lb
Initial tension is 80 lb
Effective tension is 220 lb acting on the outer rim of the pulley.

The distance is $3 \times 3.1416 \times 200 = 1885$ ft per min.
The work done is $1885 \times 220 = 414{,}700$ ft-lb.
The horsepower is $414{,}700 \div 33{,}000 = 12.57$

or $Hp = \dfrac{3 \times 3.1416 \times 200\ (300 - 80)}{33{,}000} = 12.57$

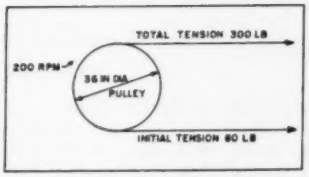


Fig. 10. Showing initial and total belt tension. Difference is effective driving Force

Examples of Belt Drive Figuring

7. A line shaft has a 24 in. diameter pulley and makes 300 rpm. A test shows a pull on the rim of 100 lb to turn the shaft. What size motor is required to drive the shaft?
R = 12 in. = 1 ft
N = 300 rpm
F = 100 lb
T = 100 lb-ft

$$Bhp = \frac{T \times N}{5252} = \frac{100 \times 300}{5252} = 5.71$$

8. A pulley is 6.0 ft in diameter and makes 100 rpm. It transmits power to another pulley without slip, with a 500 lb tension on the driving side and 150 tension on the slack side of the belt. Calculate the hp developed.
R = 3 ft
N = 100
F = 350 lb
T = 350 × 3

$$Bhp = \frac{T \times N}{5252} = \frac{3 \times 350 \times 100}{5252} = 20$$

Omitting the constant, we have:

$$Bhp = \frac{(500 - 150)\ 6 \times 3.1416 \times 100}{33{,}000} = 20$$

9. A pulley 48 in. in diameter makes 150 rpm and carries a belt transmitting 10 hp. Calculate the effective pull on the belt.
The belt speed is $4 \times 3.1416 \times 150 = 1884.96$ ft per min.
The pull on the belt is $33{,}000 \times 10 = 330{,}000$ ft-lb per min.

$$\text{Effective pull} = T_1 - T_2 = \frac{330{,}000}{1884.96} = 175 \text{ lb}$$

Checking:
R = 2 ft
N = 150 rpm
F = 175 lb

$$Bhp = \frac{T \times N}{\text{const.}} = \frac{175 \times 2 \times 150}{5252} = 10$$

10. A 28 in. dia. pulley makes 500 rpm and transmits 27 hp. What is the effective pull on the belt?

$$T = \frac{5252 \times 27}{500} = 283.5 \text{ lb-ft or } T = \frac{63{,}025 \times 27}{500} = 3405 \text{ lb-in.}$$

$$F = \frac{T}{R} = \frac{283.5}{1.167} = 243.1 \text{ lb or } \frac{3405}{14} = 243.1 \text{ lb}$$

$$F = \frac{33{,}000 \times 27 \times 12}{28 \times 3.1416 \times 500} = 243.1 \text{ lb}$$

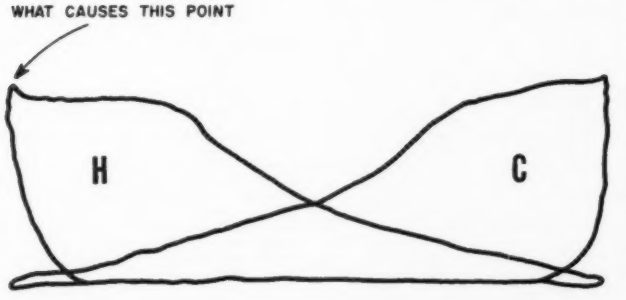
Questions and Answers

Answer No. 490

WHAT CAUSES POINT ON STEAM ENGINE INDICATOR DIAGRAM?

DESPITE the fact that many reciprocating steam engines are still operating in industrial power plants and giving good, economical service, we were surprised to receive the Corliss card shown in Fig. 1 with the question "What causes the point on the head-end admission line?"

Well, the brethren of the Ancient and Honorable Order of the Corliss Valve Gear and Dashpot rallied 'round, as the editors requested in the November issue. The letters "avalanched" on us. Below are just a few typical ones.



Steam pressure at boiler	157 psig	Back pressure	27 psig
Diameter (bore) of cylinder	34 in.	Scale of indicator spring	80
Length of Stroke	48 in.	Load	1000 kw
Diameter Piston Rod	9 in.	Generator nameplate rating	2500 kva
Revolutions per minute	100 in.	Throttle valve	Wide open

Fig. 1. Diagram from right-hand cylinder of the twin Corliss engine, actual size as it came off the indicator

Consensus of the comments agreed with our original remark that the card was very good, on the whole, the head end "bump" not very serious; in fact, some readers suggested "better let it alone." However, they did give practical comments on the cause of it, which is what O.H.D. wanted to know.

Practically everybody checked the horsepower shown by the card — approximately 1100 — but several of the brethren apparently forgot that this card is from only one cylinder of a twin engine. Technically, of course, you have no right to double it to get the horsepower for the entire engine, without also having the card for the other cylinder. However, for all practical purposes, it's probably safe to assume the other card is not too much different, otherwise this one wouldn't be so good. A small point, but always to be remembered on twin-engine indicator diagrams.

Another thing: — Note the comment of Reader A. F. Rieber about the difference between the back pressure as measured by the indicator spring and the back pressure indicated by the gage! A point many old steam-engine men will appreciate.

Q & A—THE POWER ENGINEER'S FORUM—
HERE'S HOW IT WORKS

YOUR QUESTION about some problem in operation, maintenance or design will be published, signed only with your initials.

Answers to your questions from other readers will be sent you as soon as received, then published as space permits, so that all may have the information.

You, too, answer questions from other engineers in the same way. You get paid well for published answers and also get the credit for knowing them.

If other engineers help you solve your problem, you express your thanks, via the Q & A editor.

Simple, isn't it? And effective! Just ask engineers who have tried it!

Comments by Hersey

FIRST I would like to say that the atmospheric line drawn at the time the card is taken should be reproduced the same length as the card. The one printed here is too long. The atmospheric line helps in squaring up the card.

I believe the head and steam valve opens late and the trapped exhaust steam is compressed above the initial pressure. This causes the peak. This late opening of the steam valve is aided and abetted by too early compression. Compression of one half or slightly more of the initial pressure is considered adequate.

The crank end card is satisfactory, so the steam valve on the head end should be given head equal to that of the crank end. The exhaust valve rod may be shortened a little, which will give less compression and earlier release. Release is late on head end, which in itself is not bad but compression should start later.

The average effective area of piston is 876 sq in. and the mean effective pressure, by using ordinates, for both ends is 48.9 psi. Assuming a similar card for the other cylinder, the engine is developing around 2100 hp.

Newburyport, Mass. CLAYTON H. HERSEY

Comments by Whyte

TWO CAUSES for high point on indicator diagram:

1. Inlet valve on "H" side is not being opened as wide by its lift hook as inlet valve on "C". Also, I note there is a difference of 1/16 in. in height of "H" as compared with "C", on initial pressure.
2. Dashpot on "H" side may be closing faster than dashpot on "C", thereby cutting down volume of steam entering "H".

Possible remedy:

Change dies on dashpot crank, also on lift hook. Make sure adjusting rod to "H" lift hook is properly adjusted so as to cut off at exactly same point of stroke as "C" dashpot. Adjust dashpot on "H" side so that it will close as nearly as possible with the same speed and action as "C" dashpot.

Chicago, Ill. FRED WHYTE

Comments by Van Huben

I HAVE three steam engines in my plant with Corliss-type, positive-action valves. However, these engines are now used as standbys for our steam turbine and are not run very much.

About a year ago I took cards on two of these machines and found one card with the same "hump" as O.H.D. has on his head end. But ours was much more pronounced. Still, as you mentioned, it took very little adjustment to correct.

We removed the hump by setting the head-end exhaust for slightly later closing, thereby reducing the compression. I think this is O.H.D.'s solution.

I would ignore the hump on his card as too insignificant to worry about. The amount of adjustment needed is so small that it would be difficult to obtain it without the possibility of upsetting something else. (I could be wrong!)

I suggest that O.H.D. take a card on FULL load before doing anything. Sometimes a slight imperfection at partial load will disappear at full load.

As to the ihp, well, I am including my worksheets for what they are worth. See Fig. 2.

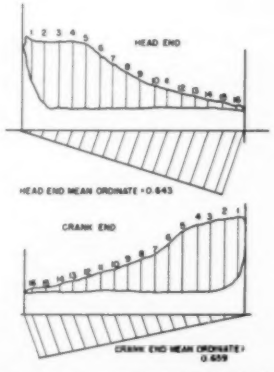


Fig. 2. Work sheets by Van Huben, showing how he got mean ordinates on diagram of Fig. 1; also how he calculated ihp

More power to your Q & A department. I turn to it first of all whenever my magazine comes in.

New York LEWIS C. VAN HUBEN

Comments by Self (Not an Old-Timer, He Says)

I CAN'T QUALIFY as an "old timer," either as to length of service around a steam engine (1 yr) or as to age (24), but I believe I can advise O.H.D. on setting his valves.

The peak will come out of the head end if he will adjust the head-end inlet valve to open a little sooner. He very possibly has a crank-end knock due to inadequate compression, which could be relieved by closing off the crank-end exhaust valve a little sooner. I would also close off the head-end exhaust valve a little later to give a little less compression.

If he is in doubt as to whether shortening or lengthening a rod will give him the desired effect, he should be able to set the valves on the fly and take cards between adjustments.

ihp Calculations:

$$ihp = \frac{PLAN}{33{,}000}$$

where L = stroke in feet = 4 ft for each end
A = piston area in sq in.
N = Strokes per min = 100 for each end
a = Card area by planimeter = 2.77 for each end
s = spring scale = 80
i = card length in inches = 4.9125 in.

$$p = \frac{as}{l}$$

A_h = 907.92 sq in. (from table)

A_c = 907.92 − 63.62 = 844.30 sq in. (from table)

$$p = \frac{as}{l} = \frac{(2.77)\,(80)}{4.3125} = 51.386 \text{ psi}$$

For the Head End

$$ihp = \frac{51.386 \times 4 \times 907.92 \times 100}{33{,}000} = 565.5$$

For the Crank End

$$ihp = \frac{51.386 \times 4 \times 844.30 \times 100}{33{,}000} = 525.9$$

Total for this one cylinder = 1091.4 ihp

Assuming left and right cylinders equally loaded

ihp (total) = (565.5 + 525.9) × 2 = 1091.4 × 2 = 2182.8

ikw = 2182.8 × 0.746 = 1628.4

Therefore Efficiency = 1000 ÷ 1628.4 = 61.4%

Woodland, Calif. E. M. SELF

Editor's Note:—All we've got to say is: If Mr. Self *isn't* an old timer on steam engines, this should qualify him for the title, even though he is only 24. (We don't like "expert"; you know what that is.) It's a pleasure, as well as a surprise, to run across young men who are actually handling steam engines and understand them. They'll learn a lot of steam engineering.

Comments by Moulton

WELL, as the editor says, let's rally around O.H.D.'s indicator diagram and analyze it. A nice pair of cards, except for the "horn" on the head end, which isn't too bad, and I notice the C end has a tiny one too. Head end shows a decided drop in pressure at rise before cutoff.

Crank end has a slight drop, followed by slight rise right after beginning of forward stroke, but has the general slope expected, especially with a piston speed of 800 fpm and long range cutoff. Compression begins rather early for the high back pressure carried, and here is the answer to what caused the point or "horn." Compression is carried up to a little above initial pressure, but not enough to loop admission line, as lead was early enough to prevent it.

Now as to the unusual rise in admission line up to point of cut off; it is probably due to either inaccurate retracing of the line in ink or the indicator piston was a little sticky.

There is not much harm if the engine does not knock at the centers, except a slight loss of power. And, of course, the remedy is a little less compression. The following data taken from the diagram might be of interest:

Length, 4.31 in.; Height, crank end, 1.89 in.; Head end, 1.81 in.

Initial pressure—Head End = 144.8 psig
Initial pressure—Crank End = 151.2 psig
Back pressure = 35.2 psig
Scale of spring = 80
Area piston = 907.92 sq in.
Area piston rod = 63.62 sq in.
Net area piston-907.92 − 63.62 = 844.3 sq in.

$$\text{Average area of piston} = \frac{907.92 + 844.3}{2} = 876 \text{ sq in.}$$

Mep—Head end = 51.92 psig
Mep—Crank end = 53.20 psig
Average Mep = 52.61 psig

$$Hp = \frac{PLAN}{33{,}000} = \frac{52.61 \times 4 \times 876.11 \times 100 \times 2}{33{,}000} = 1122 \text{ hp}$$

for this one cylinder

Pittsfield, Mass. ALBERT H. MOULTON

Comments by Gleason

I MUST AGREE with you; there is not much wrong with it. As cards go, it is a dish fit to set before a king.

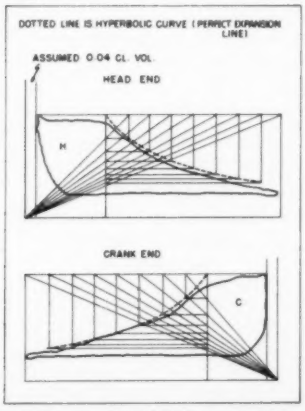


Fig. 3. Gleason assumed 0.04 clearance and drew perfect expansion line, for comparison with actual

It is so seldom that the present-day engineer has a chance to work on a card that I welcomed your invitation to analyze it even if there wasn't much that could be improved on. I think the points on the top ends are caused by excessive compression, due to exhausting against high back pressure.

Lowering the back pressure a few pounds, or if this cannot be done, shortening the exhaust-valve rods a trifle, should do away with those peaks. Rod on head end should be shortened a little, even if crank end is not touched, to equalize compression on both ends.

Pressure does not hold up during admission on the crank end, but it does on the head end; from this I would surmise that the crank-end steam valve does not open fully, during admission. This might be the result of a worn plate on the steam hook.

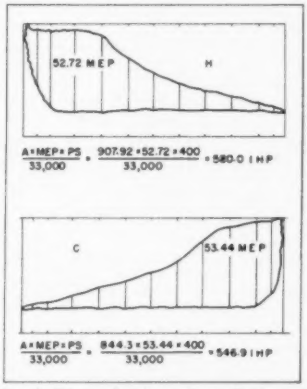


Fig. 4. Gleason found mep by ordinates and calculated ihp

The wavy lines indicate either a sticky indicator or a whipping cord.

I assumed a clearance volume of 0.04 in order to plot the hyperbolic expansion curve: the actual expansion curve follows this very closely, indicating exhaust valves and piston rings are reasonably tight.

The slight rise in the exhaust line after release has taken place would seem to indicate a small restriction, possibly a 90-deg elbow, in the exhaust pipe, close to the engine.

The indicated horsepower, computed the old-fashioned way, by drawing ordinates to find the mean effective pressure, works out to 580 hp for head end and 546.9 for crank end, a difference of 39.1 hp between the head and crank ends, not too great an unbalance. I believe bringing up the admission line on the crank end would even up the horsepower.

The engine is developing a total of 1127 hp and 66 per cent of this is being produced in electric current.

I am not going into the generator end of the works, because power factor is not mentioned and it appears that the generator is only producing 40 per cent of its rated capacity.

However the old Corliss is doing nobly and is capable of an even greater load!

In passing I would like to mention that I think the November issue of POWER ENGINEERING the most interesting one in a long time, because it contains so much down to earth material affecting power plant equipment, coal buying etc. Give with more of that stuff, brother.

Plymouth, Mich. J. E. GLEASON

Comments by Brage

O. H. D. PRESENTS a card showing only a very minor variation from what old school engineers called a "mighty good card." The point he refers to is caused by compression starting a trifle too early.

The penciled diagrams enclosed show how this happens. The method used here is not original with this writer, but was published several years ago.

This method is to impose a diagram of the engine cylinder directly upon the indicator card. The author of the original article also showed valve motion in his series of diagrams.

If the exhaust valve closes when the piston is at point A, compression begins. This is shown on the indicator card and may be marked as point a of Diagram 1.

Diagram 2 shows that the piston has moved to the end of the cylinder, that is, to point B. But the pressure of the steam trapped in the cylinder by closing of the exhaust valve has risen above the pressure of the steam in the cylinder chest. From a to b is the compression line.

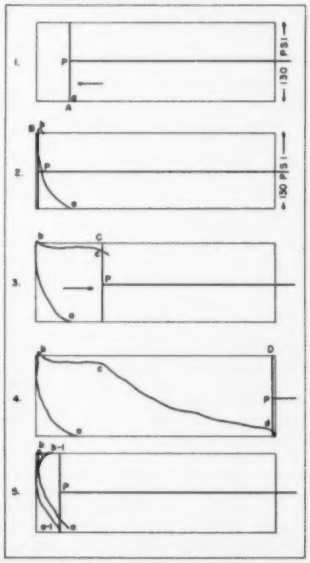


Fig. 5. Brage used method of superimposing cylinder diagram on card to show what condition is at various piston positions

Diagram 3 shows the admission line. As soon as the steam valve opens, together with the movement of the piston away from the cylinder head, the pressure in the cylinder falls to that in the steam chest. This is due partly to expansion of steam left in the cylinder and partly to live steam being admitted through the steam valve.

Diagram 4 shows the expansion line drawn from the cutoff point at c, when the steam valve closes, to end of the cylinder when the exhaust valve opens at d.

Diagram 5 shows how exhaust line is drawn as piston returns with exhaust valve open. If this exhaust valve is kept open a little longer, compression will start later, not so much steam will be trapped to cushion the piston and the pressure of the trapped steam will not rise so high. If compression is too late, line a-1 to b-1 will be drawn, and the engine may pound.

Cowiche, Wash. OLIN LEE BRAGE

Comments by Rieber

BY ALL STANDARDS, the indicator card submitted by O.H.D. is very good and the high point on the head end is not serious, for there also is a high point on the crank end diagram. Both of these high points are caused by excess compression because the exhaust valves close too early causing the excess compression. However, in scaling the diagram with an 80-lb-per-inch rule, the peak on the head end is 145 lb, then drops to 138 lb on the steam line. On the crank end the peak is 150 lb dropping to 147 lb on the steam line.

As the pressure at the boiler is 157 psig this diagram shows quite a discrepancy with the boiler pressure, which can be readily explained. Fifty or sixty years ago, when the Corliss engine was in its heyday, it was customary to locate the engine as close to the boiler as possible and provide a receiver of ample size so the drop in steam pressure was negligible. I would venture to say that all O.H.D. needs is a large size receiver whose capacity is equal to or greater than the volume of the steam cylinder; then in all probability the steam line on the diagram would almost equal the boiler pressure as the 12 in. feed line is more than ample in size. There should not be any loss in pressure unless the distance from boiler to engine is excessive, that is over 300 ft.

Information and dimensions given with the card state that the back pressure is 27 psig but scaling the diagram indicates that this back pressure ranges from 32 to 35 psig. Perhaps O.H.D.'s steam gages need checking. I have a profound faith in the accuracy of steam engine indicator springs. I have been using an old Thompson indicator for 25 years and this indicator was over 25 years old when I took charge of it. It is customary for us to indicate our two Corliss engines twice per year and every time I find it necessary to check and adjust my steam gages because the indicator diagrams show that the gages are in error.

Incidentally, we operate a single cylinder 26 by 48-in. Corliss engine under almost identical conditions. The cards from this engine are typical of the card submitted by O.H.D. except that the events on the diagrams are more sharply defined, the lines and curves are not wavy, but the steam admission lines on both ends fall off sharply from the point of admission to cutoff, which is due to the inability of the steam velocities to keep up with the piston velocity. Designers of Corliss engines have always recommended that piston speeds should not exceed 600 ft per min. because of the necessary restrictions in port areas of admission valves, even with double-ported valves and because of inadequate receiver capacities. O.H.D.'s engine has a piston velocity of 800 ft per min., which is 33 per cent greater than the recommended maximum, so he can only expect a typical card under such conditions.

However, I wish to state again that this is an exceptionally good card, which shows that all the valves are in fine adjustment, so he need not worry on this score. All the exhaust steam being used in process is being utilized to the fullest. If this was not the case, if he was exhausting to atmosphere or into a condenser, he might have some concern about leaking piston rings, leaking admission and exhaust valves. Roughly plotting the theoretical expansion curve on the expansion line indicates that his admission valves are leaking and a comparison of the mep of the crank end with the mep on the head end indicates that the crank end exhaust valve is leaking to a considerable extent. But this leaking steam is being used elsewhere, so he need not be unduly concerned unless he wants to be a perfectionist.

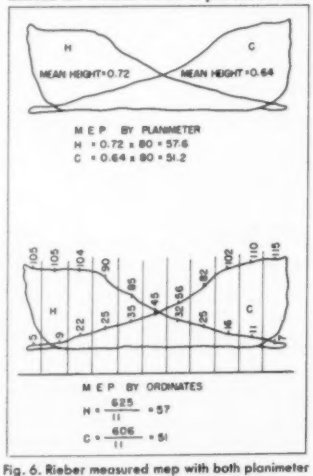


Fig. 6. Rieber measured mep with both planimeter and ordinates, which checked closely

General appearance of his card can be improved by keeping all the moving parts of the indicator well oiled and use a No. 30 piano wire on the reducing motion instead of a cotton or flax cord; 48 in. is a long stretch for a cord of fabric traveling at 800 fpm, even if the spring tension is at the maximum. The vibration set up, plus the stretch of the cord, distorts the diagram and gives it the wavy effect. Another way to reduce distortion is to have separate indicators on individual cocks at each end, because the 3-way cock on long-stroke engines certainly causes distortion. But I think O.H.D. is primarily interested in the proper valve setting; if so, this diagram very aptly indicates that the valves are set to a fine degree, for all the events are occurring at the proper time and from a standpoint of valve setting this is an ideal diagram.

Here is a computation of the ihp illustrated by Fig. 5 using both a planimeter and ordinates. The results obtained by ordinates were used in the following equations:

Head End

Mean Effective Pressure	57 lb
Length of Stroke	4 ft
Area of Piston	928 sq in.
R.p.m.	100

$$\frac{57 \times 4 \times 928 \times 100}{33000} = 641 \text{ ihp}$$

Crank End

	51 lbs
	4 ft
	864.5 sq. in
	100

$$\frac{51 \times 4 \times 864.5 \times 100}{33000} = 534.5$$

Total = H-641 + C-534.5 = 1175 ihp

Assuming that the opposite cylinder of the twin was doing equally as well, we have $1175 \times 2 = 2350$ ihp total for the twin engine.

In the above computations, the mep by ordinates was used for no other explainable reason than that I am old-fashioned and did not possess a planimeter until I was 40 years old. I may add that it is very refreshing to learn that other engineers are operating Corliss engines and, best of all, still taking indicator diagrams. I followed the sea for many years as a marine engineer and, believe me, it was quite a feat to indicate a triple-expansion engine, because three indicators had to be used and the cards were taken simultaneously.

St. Louis, Mo. A. F. RIEBER

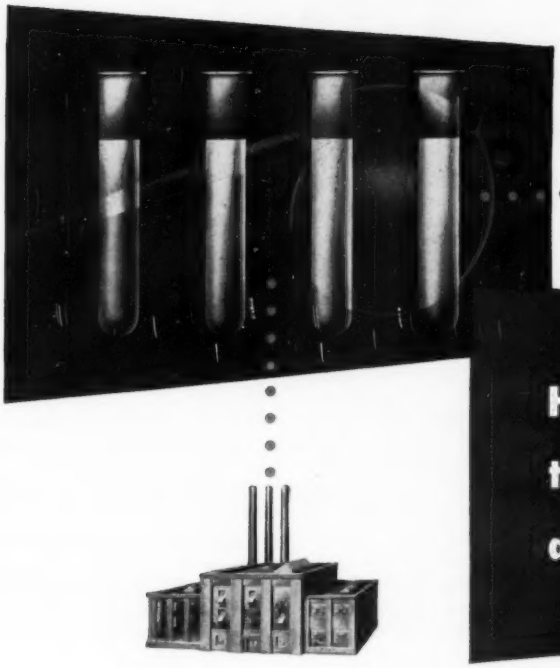
Answer No. 492

SHOULD HE BUILD SEPARATE HEATING PLANTS?

No, says Stevens

YOUR PRESENT 10 in. steam lines carry 50 psi, why not increase this to 100 psi and install reducing valves to the desired pressures? Leave existing low pressure lines at 10 psi to take care of your original load. Extend 10 in. lines at 100 psi to new buildings. Add reducing valves for desired pressures.

Baltimore, Md. THEODORE STEVANS



Here's a sure way to control carryover and blowdown

Impure steam and excessive blowdown are two "bugaboos" that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a large midwestern plant operated at 250 pounds pressure and used boiler feedwater softened by the hot lime soda process. The river water used as make-up at this plant varied widely in composition and was contaminated by a number of industrial wastes. Highly impure steam was produced with boiler water concentrations of approximately 3,000 ppm.

After analysis, Betz Engineers applied properly formulated anti-foam agents to this problem. Boiler water concentrations were raised to the extremely high value of 16,000 ppm before a similar steam impurity developed!

The positive control of carryover and boiler blowdown is only one of the many services extended by the Betz Organization. Let us explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

The VU Story

revealing the breadth of C-E's current

When you buy a boiler the manufacturer's long experience is a very important consideration, and Combustion has that. But even more significant is *current* experience . . . experience in meeting steam requirements similar to yours. And Combustion has that, too.

Here is a comprehensive picture of contracts placed for C-E Vertical-Unit Boilers during 1951. What it adds up to is that VU Boilers have nationwide and worldwide acceptance . . . that 1951 contracts represent a full range of capacities, pressures and temperatures and virtually every fuel and method of firing.

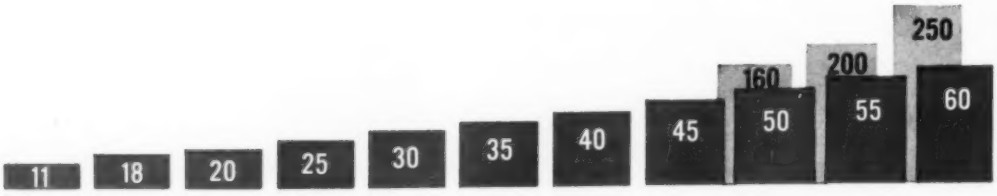
So you can select a C-E Vertical-Unit Boiler with complete assurance that your installation will not only reflect Combustion's long experience—more than 20 years—with the basic VU design but will also reflect C-E's comprehensive *current* experience in applying this design for conditions identical to yours.

Additional information on 1951 VU contracts

FUELS AND FIRING—Bituminous coal as supplied from all principal mining areas; also anthracite, lignite, oil, gas, bagasse, bark, wood and various refuse fuels. All present-day methods of firing and types of firing equipment are represented including combination firing of two or more fuels.

GEOGRAPHICAL—Units ordered during 1951 will be installed in 27 states, in seven Latin American countries and in Africa, Arabia, Australia, Canada, Israel and Spain.

INDUSTRIES—Automobile, Brewing, Building Materials, Cement, Chemical, Food Products, Government, Institutions, Lumber, Machinery, Metal Mfg., Mining, Paper, Petroleum, Public Utilities, Railroads, Rayon, Rubber, Shipbuilding, Soap, Sugar and miscellaneous manufacturing. B-559



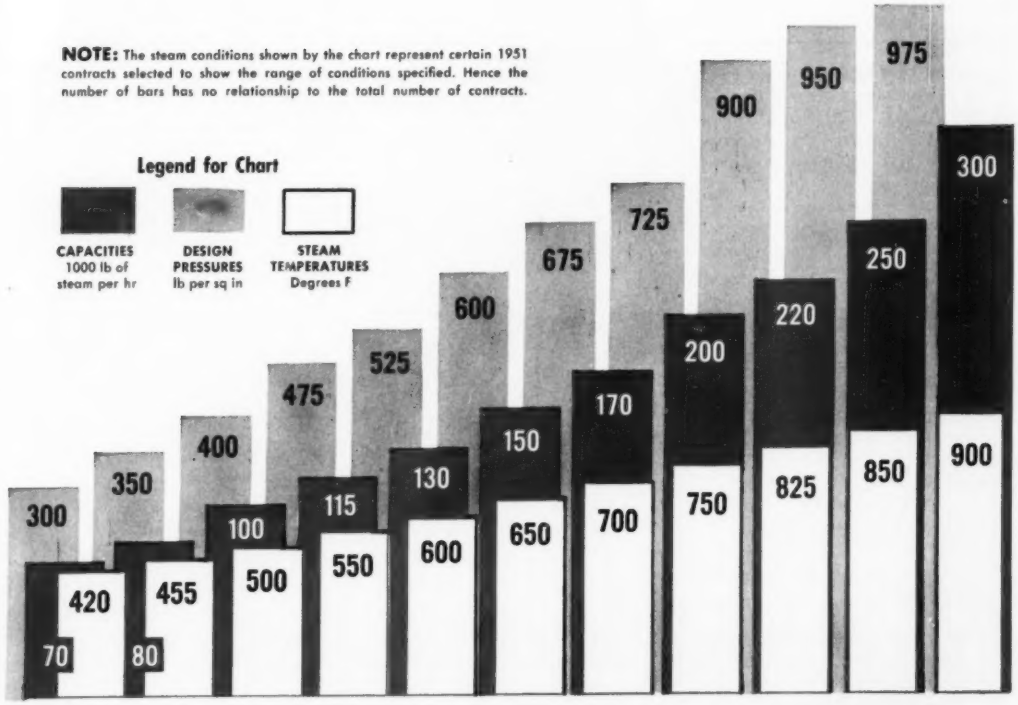
COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

for 1951

experience in the application of C-E VERTICAL-UNIT BOILERS

NOTE: The steam conditions shown by the chart represent certain 1951 contracts selected to show the range of conditions specified. Hence the number of bars has no relationship to the total number of contracts.



— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

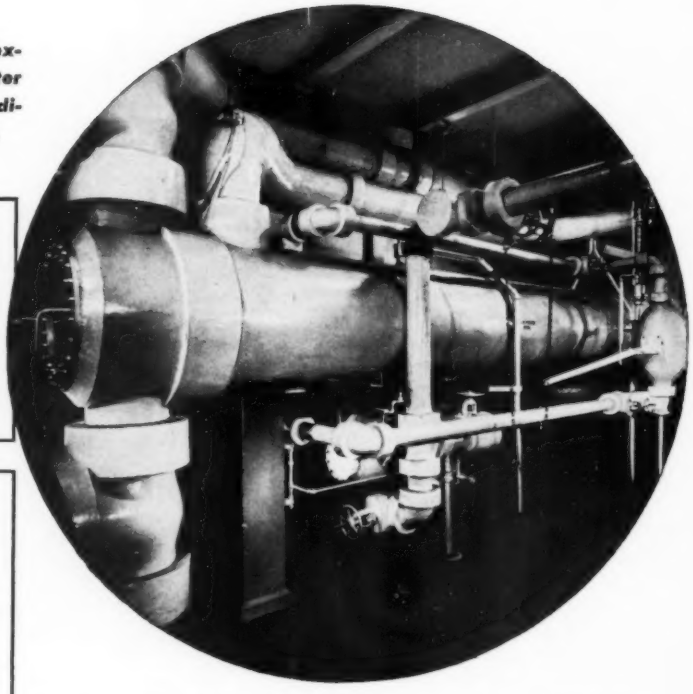
C-E

CONSIDER THESE

3 Factors

for best results in feedwater heating

Here's why you can be SURE of exactly the right feedwater heater for your particular plant conditions when you consult G-R.



1

COMPLETE LINE . . . a type for every pressure and capacity . . . a selection of three designs of stationary heads . . . four designs of floating heads . . . straight-tube or U-tube bundles . . . any combination of condensing, sub-cooling, and desuperheating in a single shell.

2

EFFECTIVE DESIGN DETAILS... breech-block head for high pressure . . . pass partition sealing plates for prevention of leakage between passes . . . special baffles for steam guidance and prevention of tube erosion . . . special air and drain baffles for improving thermal efficiency.

3

60 YEARS OF EXPERIENCE in designing and building feedwater heaters . . . many hundreds of units in stationary and marine service.

This brief outline of G-R Feedwater Heaters is explained in detail in Bulletin 279, which graphically describes the many important features that are obtainable only in G-R designs. If you will write us your requirements, a copy of this informative bulletin, together with recommendations for your particular plant requirements, will be sent without obligation.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR 232

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

The hard, cold facts about Pittsburgh's hot furnaces!

47 PLANTS OKAY THE HEAT PROVER

Pittsburgh's great steel industry needed an instrument to measure air infiltration, to check air requirement and fuel-air ratio controls in open-hearth furnaces . . . an instrument to check the stoves in which blast-furnace air is heated . . . to check precise atmospheres in soaking pits . . . to control fuel waste and precise atmospheres in processing furnaces.

THE CITIES SERVICE HEAT PROVER WAS THE ANSWER . . . and it received the stamp of approval from engineers in 47 different mills in and around Pittsburgh!

Cities Service Heat Provers . . . *not an instrument you buy, but a service we supply* . . . helped to boost furnace productivity through these five unique advantages:

1. Rapid continuous sampling.

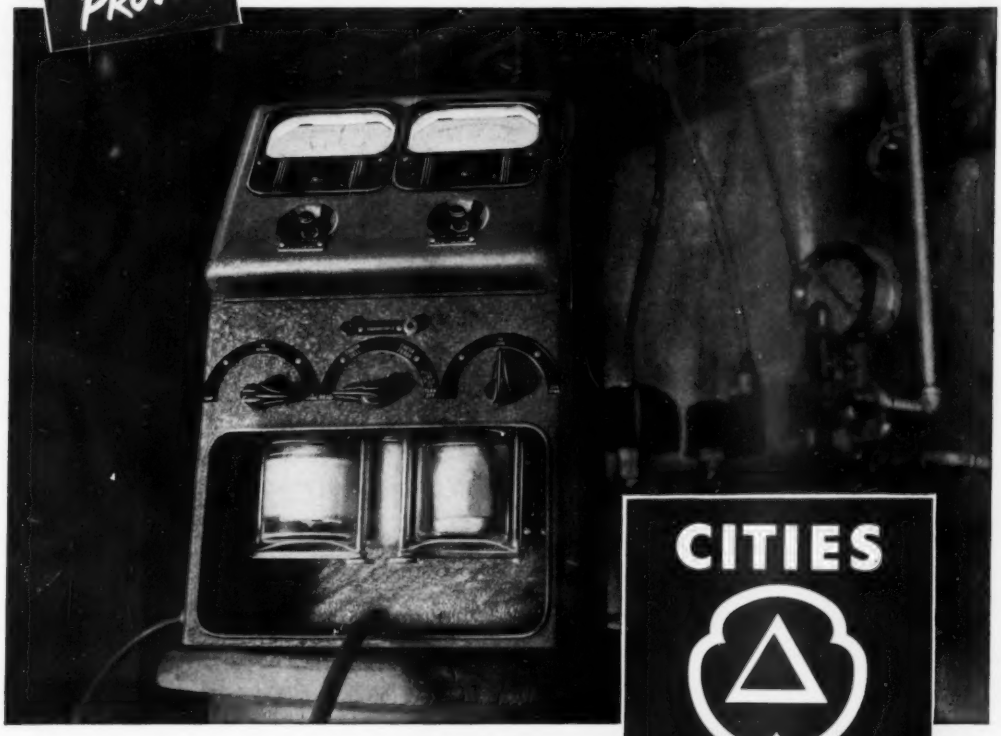
2. Simultaneous reading of oxygen and combustibles.

3. Direct measurement of oxygen and combustibles.

4. Easy portability.

5. No maintenance; no re-calibration.

These points begin to tell you why Cities Service Heat Prover analyses are just as much favored in glass, ceramics, steam generation and other fields as in the great Pittsburgh steel area. For the full story as it applies to you, write CITIES SERVICE OIL COMPANY, Dept. C23, Sixty Wall Tower, New York City 5.



CITIES SERVICE

BIDDLE

NUMBER 6 OF A SERIES

Instrument News

(Model 1B—Battery Operated Set)

FOR LOW-RESISTANCE MEASUREMENTS BETWEEN 100 AND 10,000 MICROHMS

Megger® Portable Low Resistance Ohmmeters

Self contained battery-operated and rectifier-operated types of Megger Low Resistance Ohmmeters have just been developed. They are designed for hard routine and emergency service in measuring contact resistance, such as in circuit breakers, relays, switches, bonds, connections and joints, commutator bar-to-bar tests and the like.

These portable instruments (weight 19 lbs.), are designed for low resistance measurements in the shop and in the field. They are of moderate cost and are accurate to within 1.5% of full scale deflection.

Model 1B operates from two 4 FH dry cells mounted inside the case.

Model 1R operates from a rectifier, built inside the instrument case, for connecting to 115 volts, 50-60 cycles.

Both models have a range of from .001 to .010 ohms. These new instruments operate on the same crossed-coil ohmmeter principle as the Ducter Low-Resistance Ohmmeter, with pointer indications of resistance and no necessity for balancing or voltage adjustment. Scales have fairly uniform graduations and are approximately 3¼" long. Anyone can operate this equipment—no special training or experience is required.

For particulars and prices write for Bulletin 24-46-P.E.

CABLE FAULT LOCATOR SCORES HIGH IN SAVINGS OF TIME AND MONEY

The BIDDLE IMPULSE CABLE FAULT LOCATOR combines a high-voltage capacitor discharge transmitter with a new type of detector to form a complete Tracer Current Set. This equipment has the advantages of high current and voltage output with small power input and is of moderate size, weight and cost. Also the use of this equipment is not restricted by networks or branches, and under certain conditions will even operate successfully without disconnecting transformers. Furthermore, the method of detection—which is the heart of the set—gives a positive indication of whether the fault has been reached or passed when an exploring pickup coil is applied at various points along the cable.

Equipment now in use has proved highly effective in utility and industrial service. It has made real savings for owners in both time and money. Upon written request on your company letterhead we shall gladly furnish names of users. The coupon below will bring you more details in Bulletin 65-P.E.

FREE REPRINT ON "CABLE-FAULT LOCATING PRACTICES IN PHILADELPHIA"

That is the title of an article which appeared in a recent issue of Electric Light and Power Magazine. It was written by R. S. Diggs, Assistant Superintendent, Service Maintenance Section, Philadelphia Division, Electric Transmission and Distribution Department of the Philadelphia Electric Company.

Mr. Diggs discusses the three methods of locating cable faults used on his company's underground power systems, the a-c method, the thyratron, and the impulse method.

We have obtained a limited supply of these reprints and will be glad to supply them to interested individuals so long as the supply lasts. Ask for Bulletin 65-P.E. on the enclosed card.

JAMES G. BIDDLE CO., 1316 ARCH ST.
PHILADELPHIA 7, PA.
ELECTRICAL TESTING • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT

SYNCHRONOUS MOTORS

(*Continued from page 62*)

obtaining a high power factor in a brand new plant are likely to be quite different from those feasible in an existing plant.

Table I shows the kilovars generated by synchronous motors per kw input at various power factors. Table II is a tabulation of multipliers which may be used to determine the number of kilovars required to improve power factor by given degrees. These tables may be used together to determine the approximate size of synchronous motor which would be needed to accomplish a required power factor improvement.

Besides their ability to improve the efficiency of plant power systems, synchronous motors have other desirable characteristics which make them especially suitable for many kinds of large motor drives. Some are:

1. They may be obtained at very low speeds, eliminating or reducing the need for speed-reducing gears.
2. The construction of low-speed synchronous motors results in a saving in space along the shaft when the motor is to be overhung or built into the driven machine.
3. Split rotor construction is optional in low-speed types, which facilitates assembly on shaft of driven machines.
4. Low maintenance costs are the result of inherently simple construction which leaves all parts accessible.
5. In ratings where the hp is equal to or greater than the speed, they have a lower first cost, including control and exciter, than any other a-c motor with its control.
6. A wide range of torques is available to make possible starting under heavy loads.
7. Dynamic braking brings heavy loads to a smooth, quick stop.
8. Since they run at an exact rated speed, they insure a constant rate of production in constant-speed applications. This constant-speed feature is not affected by voltage changes.
9. They have an inherently large air gap, making field assembly and maintenance easy and economical.

The combined economic and operating advantages of synchronous motors make their consideration worthwhile where any plant requires a new large motor drive. In many instances the installation of synchronous motors is the most economical method of improving plant power factor when their ability to provide efficient mechanical power at the same time is considered.

POWER AND process steam for the first commercial plant for making high-octane gasoline from coal will be supplied by four 370,000-lb. per-hr boilers, contract for which has been placed with Combustion Engineering-Superheater, Inc. The plant is being built near Johannesburg, South Africa, for the South African Coal, Oil and Gas Corp., Ltd.

For better protection of gears and drives -GULF E.P. LUBRICANTS

All the desirable properties of extreme pressure lubricants are combined in Gulf E. P. Lubricants to insure longer gear and bearing life, and lower maintenance costs for most types of gear drives.

Gulf E. P. Lubricants are specially compounded to withstand the shock loads and high pressures encountered in the toughest service, but are equally effective for all types of industrial gears, including spur, helical, bevel, spiral, worm, and hypoid gears. They prevent metal-to-metal contact and excessive wear, keep maintenance costs low.

They are outstanding in their ability to separate from water. When the proper grade is used and good maintenance practice is employed, most lubrication difficulties caused by water can be avoided.

Other advantages: nonfoaming—saves loss of lubricant and mopping up; tenacious—minimizes throwoff; extremely stable for this type of lubricant; help prevent rust; and they are just as suitable for the lubrication of all types of bearings.

Gulf E. P. Lubricants are available in the proper viscosity for every gear requirement, ranging from 55 to 1050 S.U.V. at 210°F. For specific recommendations for your equipment, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office, or send the coupon below.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company PE
719 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of your pamphlet "Gulf E. P. Lubricants."

Name.....

Company.....

Title.....

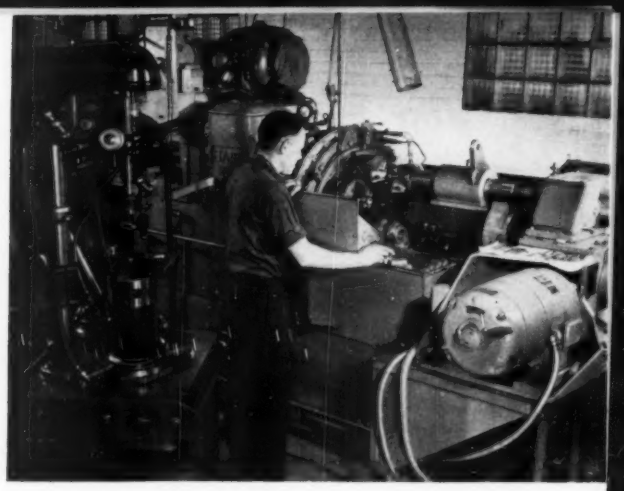
Address.....

valve values
PHOTO NEWS

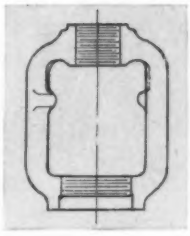
Edward Builds Valve Performance

THROUGH EXCLUSIVE SHOP PROCESSING

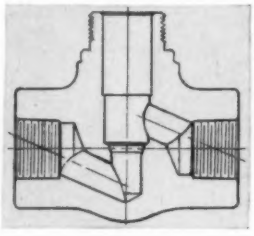
Today's turbines, boilers, refinery cracking units, and chemical apparatus are major equipment items that operate continuously for long periods with great reliability. Poorly made valves can cause expensive shutdowns of large investments. Edward's know-how in building steel valves dates from 1904. Costly special machinery in the Edward plant is designed to make valve parts which insure long, trouble-free service. Illustrated are two machines, exclusive with Edward, designed to process strong, drop forged parts with perfect alignment and concentricity, plus fine finishes and tolerances. Add top-notch shop men—then Edward users get the best in plus-value valves.



A unique and exclusive Edward machine tool, combining the best features of Baird, Goss-DeLeeuw, and Edward designs, makes small valve bodies with perfect alignment and finish in one operation. Rockwell-Delta drill presses (left) finish parts for immediate final inspection.

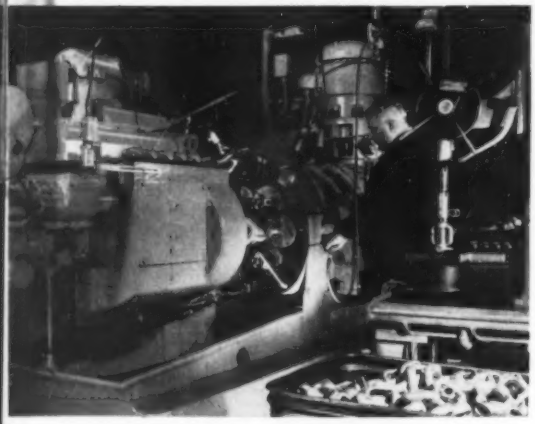


YOKE



BODY

The valve yoke and body *above* look simple, but require the high priced tools illustrated. Every part must be in perfect alignment. By doing the machine operations on such parts in one set-up, valves will go together just right. On the yoke (*left*) both threads are made in one operation. All bonnet-end operations of the drop forged valve body are finished in one set-up.



Exclusive tooling on this "work-rotating chucker" finishes both ends of forged valve yokes simultaneously. One machining operation does the entire job, insuring precision alignment of valve yoke bushings, stems, disks, packing glands, and backseats.

Special gages check alignment of Edward Fig. 952 yoke immediately after making.

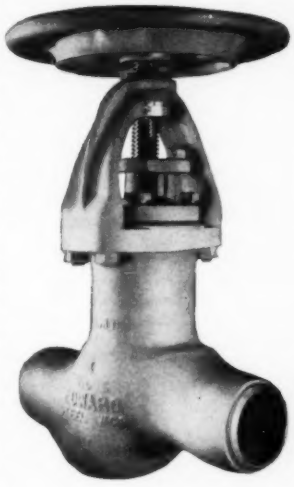
The finished valve parts go together perfectly.

Edward Valves, Inc.

Another Rockwell Product

New Edward PRESSURE-SEAL* Bonnet Construction

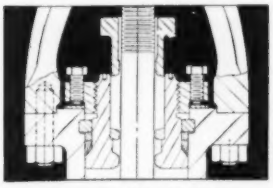
The successful use of pressure seal bonnet valves during recent years has brought to light some problems in the design in smaller sizes. The valve designer, faced with fitting into the bonnet bore a stem, bonnet, pressure sealing gasket, spacer ring, retainer ring, packing chamber, and gasket loading mechanism, found some sacrifices would have to be made unless cost and valve dimensions could be ignored.



The first solution consisted of a large lugged nut gasket pull-up, screwed on to the bonnet and bearing on the top of the yoke base or the retainer ring, so that turning the nut pulled the bonnet upward and deformed the gasket.

This construction (never used by Edward) was found difficult to use in the field. The large diameter threading on the lugged nut, together with the broad bearing surface of the nut, made it difficult to accurately determine the load being applied to the gasket even under favorable conditions. Further, because of moisture in the packing chamber area, the loading mechanism threads frequently corroded badly, making adjustment difficult and service performance more in doubt.

In the smaller sizes, internal pressure provides only part of the load required for gasket deformation. Consequently, positive mechanical loading is even more important than in large valves. Believing that uniform and accurate loading of the gasket is vital to satisfactory performance of all pressure sealed bonnet valves, Edward has provided additional space in 5 in. and smaller PRESSURE SEAL* valves by using a yoke outside the normal position.



An exclusive Edward design

Illustrated is a 4 in. 900 lb Edward PRESSURE SEAL* globe valve so constructed. Note this permits the use of four small readily accessible, individually loaded studs resting on a hardened bearing plate on top of the valve body. Torque may be applied accurately to each of the four pull-up studs, and the gasket loading uniformly distributed around the gasket contact area circumference. See cross-section view. All Edward PRESSURE SEAL* valves have high gasket loading with low individual torque load on the pull-up studs. In addition, they have exclusive features such as scientifically streamlined bodies, integral Stellited seats, and Impactor handwheels as standard construction.

*TRADE MARK REG.

EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY

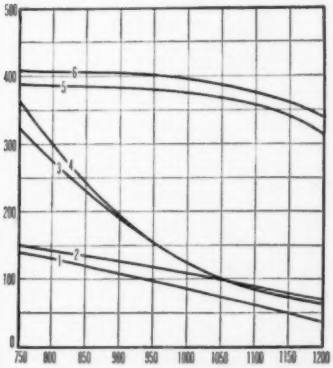
220 WEST 144TH STREET
EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

Technical Tips

What Heat Does to Valve Trim Hardness

Valve "trim" refers to working parts such as seats, disks and wedges, in contact with line fluid. Hardness, usually expressed as "Brinell" or "Rockwell" is an important requirement in temperature and erosion services. Ability to retain room temperature hardness largely determines valve trim life in many services above 800 F. Chart below shows what continued heating does to hardness of several trim alloys. Base line hardnesses at 750 F approximates room temperature hardnesses for all these materials. Also charted, as a basis for comparison, are hardness-temperature curves for two common valve body materials.



HARDNESS AT TEMPERATURE OF VARIOUS VALVE MATERIALS

1. A.S.T.M. A216—WCB—Valve body material.
2. A.S.T.M. A217—WC6—Valve body material.
3. Edward EValloy—400 BHN—Valve trim material.
4. Type 420—500 BHN—Valve trim, material.
5. Hastelloy 21—Heat treated, valve trim material.
6. Stellite No. 6—Valve trim material.

• • •

Edward EValloy, a 400 Brinell, low carbon high strength 13 per cent chromium stainless, employed by Edward since 1921, and the Type 420 (more brittle and slightly less corrosion resistant) high carbon, 13-16 per cent chromium stainless steels lose hardness rapidly above 750 F.

For toughness at higher temperatures, Stellite, acobalt-chromium-tungsten alloy, and Hastelloy, a cobalt-chromium-molybdenum alloy hold hardness well to 1200 F, and are ideal for erosive throttling services at all temperatures. Of the two, Stellite is the more widely used for valve seating surfaces. Both have good corrosion resistance.

Monel metal, a copper-nickel alloy, and "18-8" chromium-nickel alloys lack high hardness needed for temperature and erosion resistance, but serve well in many corrosive services.

Edward

Little stories of big savings in LAGONDA tube cleaning

The case of the Insistent Engineer

Happened at an important middle western utility. One of the engineers kept insisting that the water treatment they were using should be supplemented by occasional mechanical tube cleaning, which had not been used for four years. Nobody believed him, but his persistence finally won out to the effect that they consented to clean one boiler with Lagonda tube cleaners, just to see. Result, startling increased efficiency of the unit, an unexpectedly large amount of scale removed, and the scheduling of Lagonda cleaning for all the boilers not only in that plant, but in all other plants of the system. Further result, orchids for the insistent engineer.

Y-2-1

GET BULLETIN Y-29
with details on all types of cutter heads and motors for cleaning all tubes, small, large, curved, straight. On request.

LAGONDA
...the oldest name in tube cleaning!

ELLIOTT COMPANY
LAGONDA DIVISION · SPRINGFIELD, OHIO
Plants at: Jeannette, Pa. • Ridgway, Pa. • Ampere, N. J. • Springfield, O. • Newark, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

HEAT RATES

(*Continued from page 65*)

is shown on Fig. 5 and includes losses in turbine expansion from line to exhaust flange but does not include shaft and packing leakage. This must be handled separately because it varies with reheat pressure and arrangement of turbine casing. Efficiency read from Fig. 5 must be corrected by a multiplying factor of 0.99 for the reheat turbine arrangements shown in the paper.

The low-pressure section of a reheat unit does not have the usual control valves and does not have a governing stage hence it is a little more efficient than the equivalent straight condensing unit.

Expansion lines for high and low-pressure reheat sections are determined by the same general method as with non-reheat, except it is necessary to choose a desired reheat pressure and temperature and a value for pressure drop through reheater and connecting piping, usually about 10 per cent of the reheater inlet pressure. Then, by the same methods indicated above, taking data and suitable correction factors from curves given in the paper, total turbine wheel output can be calculated.

This wheel output must then be reduced by the end packing losses, from curves. These losses are included in Fig. 4 but not in Figs. 5 and 6. Thus the corrected total reheat turbine wheel output is obtained. The mechanical losses (from curves) and the generator efficiency are then applied (two efficiencies for a cross-compound unit) and overall turbine heat rate calculated in the usual way.

Cross-Compound Non-Reheat Units

Efficiencies of these are determined similarly, correcting by a multiplying factor of 1.002 to allow for the non-existence of the intercept valve. Here again, correction must also be made for end packing leakage loss.

This GE paper concludes with an appendix showing in detail the calculations for the expansion lines of tandem-compound non-reheat turbines and for reheat turbines.

FIRST ANNUAL MEETING, AMERICAN POWER CONFERENCE

Formerly Midwest Power Conference

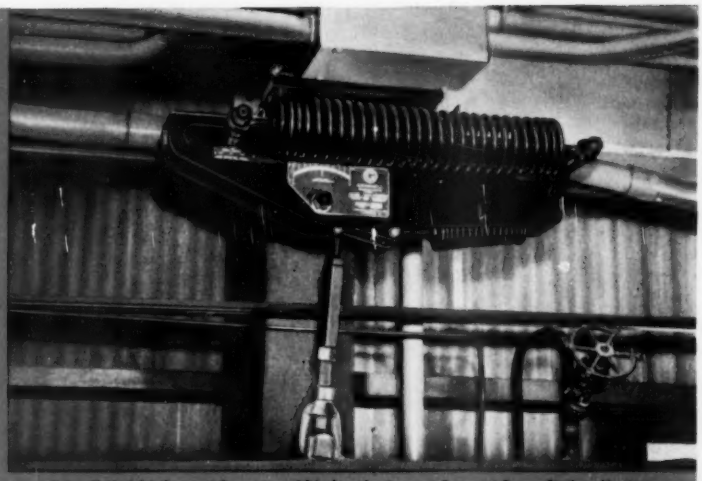
March 26-27-28, 1952
SHERMAN HOTEL, CHICAGO

AMERICAN Power Conference is the new name adopted this year for the former Midwest Power Conference. This was announced in the February issue, page 59.

The name was changed, according to Conference Director Budenholzer of Illinois Institute of Technology, to describe more accurately the scope and character of the conference. For a number of years it has been the only

PIPING THAT MOVES

. . . calls for supports that are flexible



Grinnell Model L Constant-Support on 12-inch main steam at Somerset Power Station, Montaup Electric Co., Somerset, Mass. Pressure, 1300 psi; temperature, 930°F; load, approximately 6900 pounds. Note minimum headroom available.

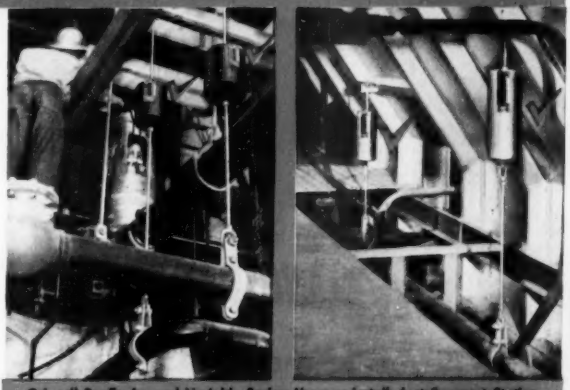
Thermal deflection of piping in today's high pressure, high temperature power stations necessitates flexible support of piping.

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant-support type hangers are recommended. They are designed to provide substantially uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

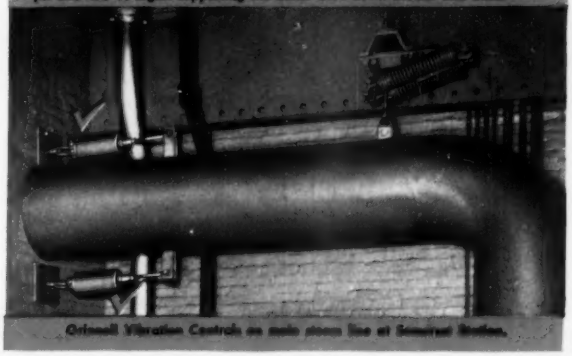
When pipe lines are subject to vertical movement and restrictive conditions do not require the use of a constant-support type, variable spring hangers are recommended. They should be designed to support not less than 85% or more than 120% of the designed load for the total travel.

When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting, counter force type are recommended.

Grinnell manufactures a complete line of engineered pipe hangers and supports; maintains a laboratory staff of trained technicians; provides highly skilled assistance and advice right from the design stage; and offers experienced field engineering service.



Grinnell Pre-Engineered Variable Spring Hangers installed at Somerset Station. Left: supporting boiler feed discharge lines, carrying steam at approximately 1780 psi and 455°F. Right: supporting the boiler blow-down header and lines.



Grinnell Vibration Controls on main steam line at Somerset Station.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

YOU CAN'T BUY A BETTER COAL SCALE THAN A RICHARDSON

..AND HERE'S ANOTHER REASON WHY..

INLET OPENING, 20" x 20"

This 400-square-inch opening, *exclusive with Richardson,* ensures positive coal flow and never a "hang-up"—even with wet coal. An even greater area at the conveyor belt, due to the angle of repose of the coal providing pressure relief, is a double guarantee of free flow. It is designed to guarantee the ultimate in dependable, on-the-job operation.

Write for bulletins, and remember . . .

YOU SPECIFY QUALITY WHEN YOU SPECIFY

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston
Buffalo • Chicago • Cincinnati
Detroit • Houston • Minneapolis
New York • Omaha • Philadelphia
Pittsburgh • San Francisco • Wichita
Montreal • Toronto

8353

conference devoted solely to power engineering. Although it was originally started as a Midwestern conference and sponsored by Midwestern engineering colleges and other professional organizations, the quality of the meetings soon began to draw attendance from outside the Middle West. In fact, during the past 4 or 5 years, attendance at the Chicago conference has included engineers from all over the country, from Canada and from Mexico.

Consequently, the conference has truly developed into an American conference, hence the new name and the announcement of its first meeting under that name.

The conference is sponsored, as before, by Illinois Institute of Technology with the participation of the same group of engineering schools and technical and professional societies. This year, the Association of Edison Illuminating Companies and the Edison Electric Institute join the cooperating groups.

The preliminary program, as of the deadline, is given below.

Wednesday, March 26, 1952

9:00 A.M. Registration, Sherman Hotel

10:00 A.M. *Opening Meeting* — Grand Ballroom. Chairman: Edward J. Doyle, Vice-Chairman, Commonwealth Edison Co., Chicago.

(a) Address of Welcome. The Honorable Martin H. Kennelly, Mayor of Chicago.
(b) Address. George M. Gadsby, President, Edison Electric Institute and President, Utah Power and Light Co., Salt Lake City, Utah.
(c) Address. C. H. Lang, Vice President, General Electric Co., New York.

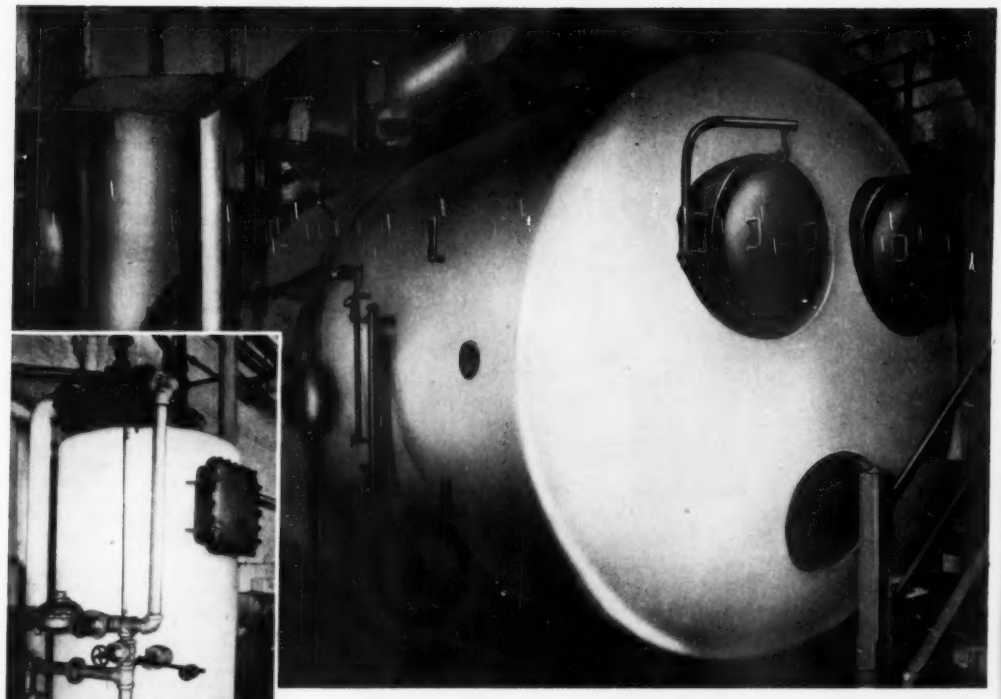
12:15 P.M. *American Power Conference Luncheon* — Bal Tabarin Room, Sixth Floor (Everyone Invited). Program Sponsored by Chicago Section of A.S.M.E., D. J. Bergman, Chairman.
Presiding: Alex Bailey, Vice President, Commonwealth Edison Co., Chicago. Speaker: Pressly H. McCance, President, Association of Edison Illuminating Companies and President, Duquesne Light Co., Pittsburgh, Pa.

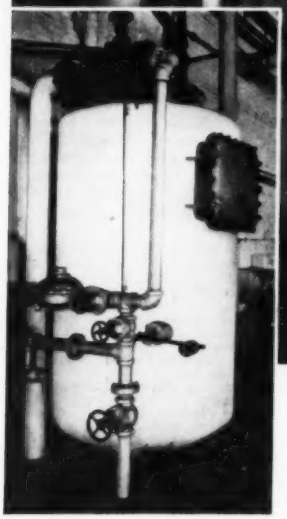
2:00 P.M. *Central Station Steam Turbine Generators* — Grand Ballroom. Chairman: G. A. Gaffert, Partner, Sargent & Lundy, Chicago.

(a) Thermal Efficiency and Design of High Temperature and Reheat Turbine-Generator Units. T. R. Carlson, Manager, Application Engineering Department, Westinghouse Electric Corp., South Philadelphia, Pa.
(b) Controls of Modern Steam Turbine-Generator Units. Charles F. Wilson, Engineer in Charge, Large Turbine Design, Allis-Chalmers Manufacturing Co., Milwaukee, Wisc.

2:00 P.M. *Industrial and Small Plants* — Louis XVI Room. Sponsored by the National Association of Power Engineers. Chairman: John H. Herzog, President, National Association of Power Engineers, San Francisco, Calif.

(a) The Development and Application of Water Tube Package Steam Gen-





A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

Send your water treating problem to Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

S.1.5

A GREAT TEAM IN STEAM

Feedwater Heaters

Ejectors

Boiler Feed Pumps

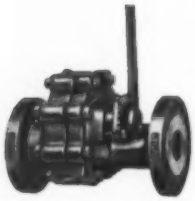
Water Treating Equipment

Steam Turbines

Surface Condensers

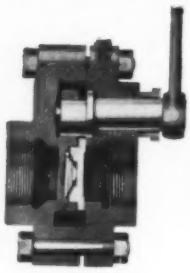
EVERLASTING VALVES

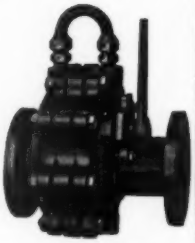
Mean "Everlasting" Protection on these duties



GENERAL SERVICE

Wherever frequent use and quick operation is required for any liquid or gas at pressures up to 300 psi. These valves have outside stuffing box and gland.





STEAM JACKETED

Assure continued free flow of any material which congeals at ordinary temperatures.

FIRE PROTECTION

Closing type for inflammable liquid emergency shut-off, or opening type for deluge or drainage, assuring immediate and positive action with weighted pendulum stop.

BOILER BLOW-OFF

Quick-opening, also handwheel operated. Angle and "Y" types and combination units meeting ASME Code requirements for pressures up to 600 psi.

BOILER WATER COLUMN

With indicator and locking device. Meets ASME Code requirements.

EVERLASTING FEATURES

For more than 40 years, EVERLASTING VALVES have been known for their ingenious design, simple sturdy construction, and long trouble-free life with low maintenance expense. Some of their distinctive features are:

Quick-Action . . . opened or closed with less than a quarter turn of the operating lever.

Straight-Through Flow . . . the disc cannot become loose and accidentally check the flow.

Drop-Tight Seal . . . constant contact of disc and seat at all times prevents dirt or scale from getting between.

Self Regrinding . . . the disc rotates on the seat with each operation, thus regrinding the sealing surfaces.

No Wedge Action . . . all parts move between parallel faces.

Write for bulletin describing EVERLASTING VALVES in detail.

EVERLASTING VALVE CO.

49 FISK STREET, JERSEY CITY 5, N. J.

Everlasting Valves

Trade-Mark "EVERLASTING" REG. U. S. PAT. OFF.

for everlasting protection

erators. N. O. Kirkby, Executive Engineer, Vapor Heating Corp., Chicago.

(b) Coal Dust Control with Liquid Diffusion Compounds. G. A. Mau, Vice President, Johnson March Corp., Philadelphia, Pa.

2:00 P.M. *Electrical Distribution* — Crystal Room. Chairman: D. D. Ewing, Head, Department of Electrical Engineering, Purdue University, West Lafayette, Indiana.

(a) and (b) To be announced.

3:30 P.M. *Modern Steam Generators* — Grand Ballroom. Chairman: Frank D. Carvin, Chairman, Department of Mechanical Engineering, Illinois Institute of Technology, Chicago.

(a) Trends in Modern Central Station Boiler Design. H. B. Wallace, Jr., Manager, Steam Sales, Foster Wheeler Corp., New York.

(b) Considerations in the Design of Large Central Station Boilers. W. A. Rowand, Chief Engineer, The Babcock and Wilcox Co., New York.

3:30 P.M. *Training of Power Plant Operating Personnel* — Louis XVI Room. Sponsored by the National Association of Power Engineers. Chairman: Leslie F. Clifford, Associate Editor, *National Engineer*, Chicago.

(a) Human Relations in Personnel Practice. Stephen C. Casteel, Assistant Manager, East St. Louis and Interurban Water Co., East St. Louis, Ill.

(b) Experiences and Results of Personnel Training Courses. O. P. Stamtal, Supervisor of Training Division, Union Electric Co. of Missouri, St. Louis, Mo.

(c) Present and Future of Personnel Training in the U.S.A., W. F. Patterson, Director of Bureau of Apprenticeship, United States Department of Labor, Washington, D. C.

3:30 P.M. *Industrial Systems* — Crystal Room. Sponsored by Industrial Group, Chicago Section, AIEE Chairman: Fred W. McCloska, Electrical Engineer, Sargent and Lundy, Chicago.

(a) Interconnection of Industrial and Public Utility Systems. V. F. Estcourt, General Superintendent of Steam Generation, Pacific Gas and Electric Co., San Francisco, Calif.

(b) Electric arc Furnaces as an Electric Utility Load. B. M. Jones, Planning Engineer, Duquesne Light Co., Pittsburgh, Pa.

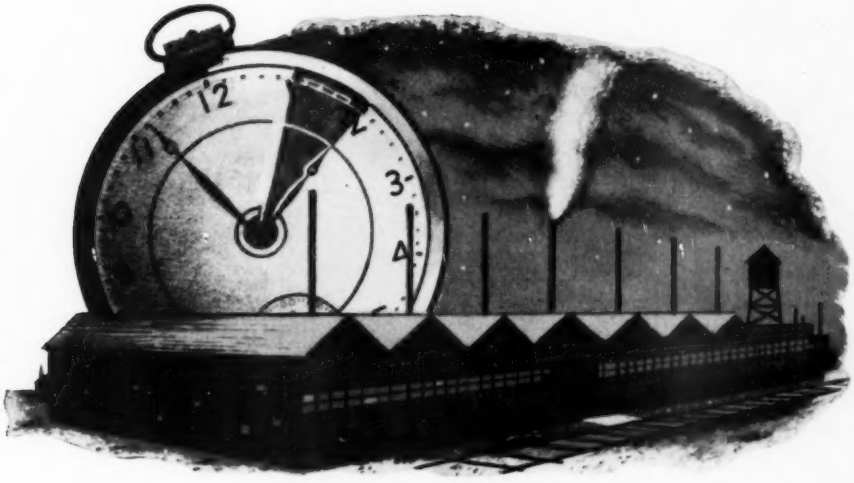
7:30 P.M. *Outlook for American Free Enterprise* — Louis XVI Room. Arranged and sponsored by the Industry Committee. Chairman: J. B. Thomas, President Texas Electric Service Company.

(a) Federal Power in the Missouri Valley, N. Bernard Gussett, President, Iowa Power and Light Co., Des Moines, Iowa.

(b) Necessity of Coordinating Efforts to Maintain the American Free Enterprise System. Leo E. Brown, Director of Public Relations, American Medical Association, Chicago.

Thursday, March 27, 1952

9:00 A.M.–12:00 Noon. *Water Technology Session No. 1. Symposium on Ion Exchange* — Grand Ballroom. Sponsored by Water Technology Division of the Chicago Session of ASME. Chairman: Louis



How to reduce DOWNTIME with STEAM TRAPS

What do you expect from your steam traps? To drain condensation . . . to vent air, and to prevent the escape of live steam?

Any good trap can do this job. But what about that other important factor, keeping those vital steam lines operating continuously?

The careful design and exclusive construction of Super-Silvertops prevents costly downtime in two ways.

First, rugged and strong . . . they eliminate downtime caused by the continual replacement of parts in steam traps. Super-Silvertop valves and seats are made of longer lasting Anderloy* alloys . . . and the bucket is guided on a patented center tube that eliminates bucket damage.

Second, well designed . . . they reduce downtime because they are much faster to install and inspect. Three pipe connections in the head permit the trap to be installed straight-in-line or as an elbow . . . saving 50 minutes whenever a trap is installed . . . 30 minutes whenever serviced.

Thousands of leading refineries, food processing, chemical and other industrial plants have saved hours of downtime with Super-Silvertops. You can too.

Get the complete story today . . . send for a copy of Solving Steam Traps Problems. Mail Coupon.

SUPER-SILVERTOPS SAVE MONEY

THE V. D. ANDERSON COMPANY
1977 West 96th Street • Cleveland 2, Ohio

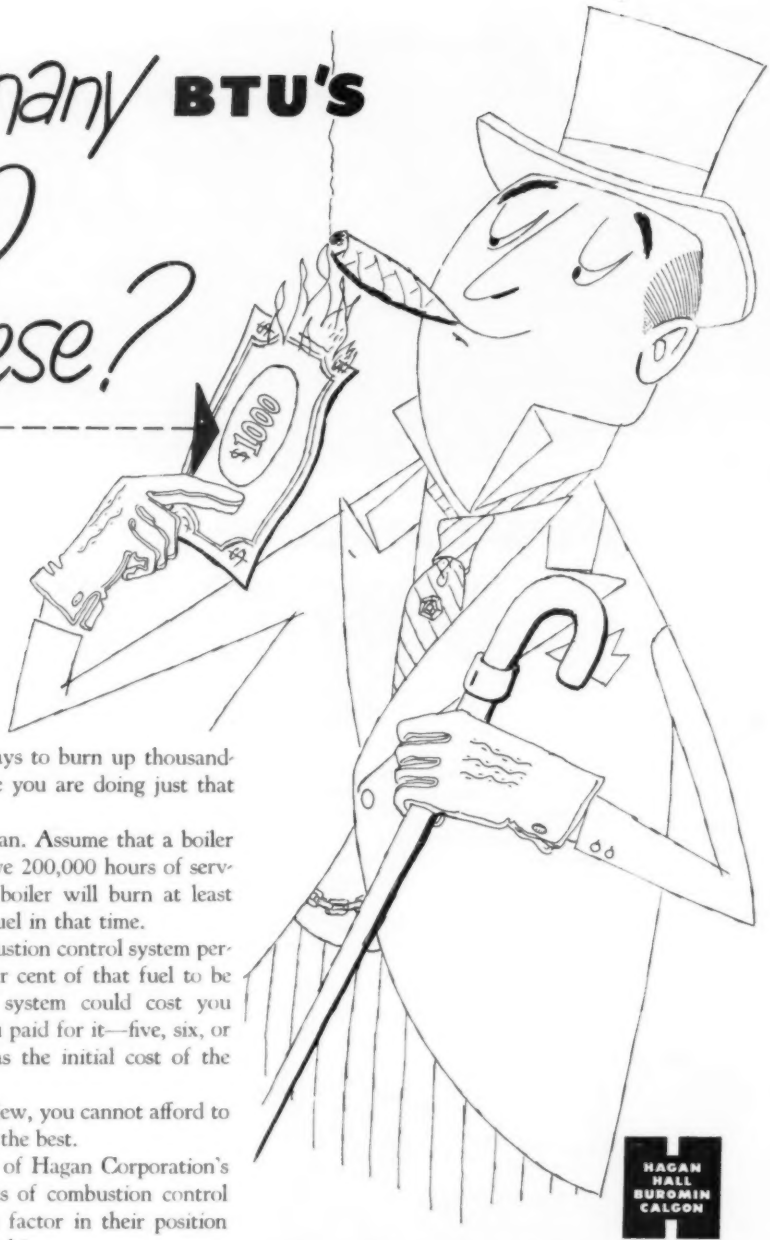
Gentlemen: Please send without obligation your book "Solving Steam Trap Problems."

Name .....

Address .....

City ..... State .....

In Canada: Bawden Machine Co., Toronto

how many BTU'S in 80 of these?

THERE are other ways to burn up thousand-dollar bills, and maybe you are doing just that in your boiler room.

This is what we mean. Assume that a boiler may be expected to give 200,000 hours of service. A 100,000 lb/hr boiler will burn at least $8,000,000 worth of fuel in that time.

Now—if your combustion control system permits as little as one per cent of that fuel to be wasted, your control system could cost you $80,000 more than you paid for it—five, six, or seven times as much as the initial cost of the system itself!

From this point of view, you cannot afford to buy anything less than the best.

The long experience of Hagan Corporation's engineers with all types of combustion control applications is a prime factor in their position of acknowledged leadership.

For full information, write to:

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

Wirth, Jr., Special Service Engineer, Zeolite Department, National Aluminate Corp., and Chairman, Water Technology Division, Chicago Section, ASME, Chicago.

(a) Demineralization Plant Operational Experiences. M. E. Brines, Assistant Superintendent of Power, Dow Chemical Co., Midland, Mich.
(b) Initial Operation of a 500-GPM Duplex Deionizing Plant. T. P. Harding, Chemist, Omaha Public Power District, Omaha, Nebraska.
(c) Hot Lime Zeolite — A 290 deg. F Installation. A. Simpson, Macon Kraft Paper Co., Macon, Ga.

9:00 A.M. *Power Plant Auxiliary Equipment* — Louis XVI Room. Chairman: Elmer C. Lundquist, Acting Head, Department of Mechanical Engineering, State University of Iowa, Iowa City, Iowa.

(a) Recent Developments in High Pressure Boiler Feedpumps. I. J. Karassik, Application Engineer, Worthington Pump and Machinery Corp. Harrison, N. J.
(b) Demand Performance-Fluid Drive in The Modern Power Plant. Ben Ragland, Manager, Hydraulic Coupling Division, American Blower Corporation, Detroit, Mich.

9:00 A.M. *Electrical Transmission* — Crystal Room. Chairman: J. A. M. Lyon, Associate Professor of Electrical Engineering, Northwestern University, Evanston, Ill.

(a) Experience with 230-Kv on Large Power Systems. A. A. Osipovich, Chief, Transmission Design Section, and H. L. Rorden, High Voltage Practice Engineer, Bonneville Power Administration, Portland, Oregon.
(b) Conductor Size — Its Technical and Economic Effects on Transmission and Distribution. R. M. Butler, Central Station Engineering Divisions, General Electric Co., Schenectady, N. Y.

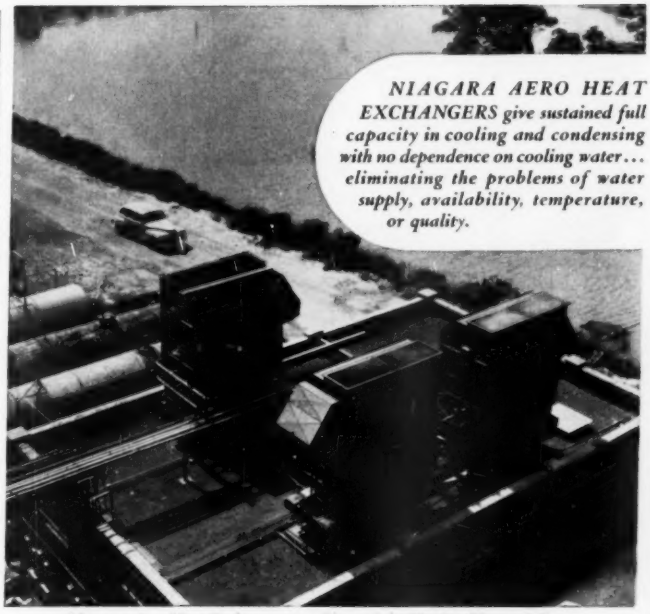
10:30 A.M. *Hydro Power* — Louis XVI Room. Chairman: E. Montford Fucik, Vice President, Harza Engineering Co., Chicago.

(a) The Multipurpose Columbia River Development Program. Erwin C. Hannum, Program Coordinator, Bonneville Power Administration, Portland, Oregon.
(b) Kemano-Kitimat, Producer of Packaged Hydro Power. F. L. Lawton, Chief Engineer, Power Department, Aluminum Laboratories Ltd., Montreal, Canada.

10:30 A.M. *Public Utility Noise Problems* — Crystal Room. Chairman: E. T. Vincent, Head, Department of Mechanical Engineering, University of Michigan, Ann Arbor, Michigan.

(a) Noise Problems and Prevention of Noise in Public Utility Properties. W. F. Friend, Ebasco Services, Inc., New York.
(b) Determination of Design Characteristics for Noise Control of Power Plants. H. C. Hardy, Assistant Chairman, Physics Research, Armour Research Foundation, Chicago.

12:15 P.M. *American Power Conference Luncheon* — Bal Tabarin Room, Sixth Floor. Sponsored by Chicago Section of AIEE, W. M. Ballenger, Chairman. Presiding: Walker Cisler, President, Detroit Edison Co., Detroit, Mich., Speaker: Philip Sporn, President, American Gas


NIAGARA AERO HEAT EXCHANGERS give sustained full capacity in cooling and condensing with no dependence on cooling water... eliminating the problems of water supply, availability, temperature, or quality.

Niagara Aero Heat Exchangers at a Plant of the Heyden Chemical Corp.

Still Operations Improved by a New Cooling Method

• NIAGARA AERO HEAT EXCHANGERS cool the reflux supply or condense vapors at a vacuum by controlled evaporation of water directly on the heat exchange surfaces.

Liquid or vapor temperatures are always held constant by the Niagara "Balanced Wet Bulb" control method, which automatically varies the cooling effect proportionately to the load. The distillation is therefore uniform throughout all changes in climatic conditions the year around; it is the same in the heat of summer as in the freezing cold of winter. Continuous maximum production is thus insured.

Non-condensibles are effectively separated at the condensate outlet, with notable sub-cooling after separation for greater vacuum pump efficiency.

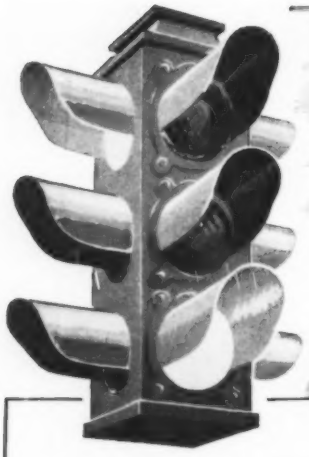
Use of Niagara Aero Heat Exchangers reduces your operating costs and removes many sources of your troubles in distillation column operation. Ask for new bulletin #120.

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. E , 405 Lexington Ave. **New York 17, N. Y.**

Experienced District Engineers in all Principal Cities of U. S. and Canada



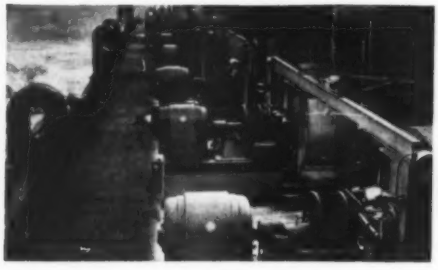
DRAFT FANS GO on GREEN

A Big Draft Job Handled Capably by Green Fans

Twenty-four large Green Fans take care of a heavy draft load at the Venice (Illinois) Plant of the Union Electric Co. of Missouri. Each of six boilers has two sets of Green Fans, each set consisting of one induced draft fan and one forced draft fan coupled to one motor as a unit. With the heavy demands on this station, all boilers are usually in service continuously, thus throwing an unrelenting burden on the fans.

Engineers whose responsibility it is to recommend or accept draft fans for large power plants certainly want efficiency and low operating costs. But they don't overlook the maintenance and replacement angles. They want the sound designs of competent experienced fan engineers. They also want the care in construction that is found in shops of a company that has built up an international reputation as the "authority" on draft fans. They know that such a company will not tolerate sloppy shop work.

Green is this authority on mechanical draft fans.



Have You a Copy of Our Fan Bulletin No. 168? If not, we shall be glad to send you one.

THE GREEN Fuel Economizer COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

and Electric Service Corp., New York.

2:00 P.M. *Public Attitude and What Can Be Done About It* — Grand Ballroom.

(a) What the People Think About Socialism. Claude Robinson, President, Opinion Research Corp., Princeton, N. J.

(b) Our Responsibility in Correcting Socialist Idealogy. Edwin Vennard, Vice President, Middle West Service, Co., Chicago.

2:00 P.M. *Steam Condensers* — Louis XVI Room. Chairman: J. W. Andeen, Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn.

(a) Fundamental Designs and Design Considerations of Industrial Condensers. G. H. Putnam, Manager, Condenser Department, Ingersoll-Rand Co., New York.

(b) Condenser Circulating Pump Intakes. W. W. Wiltmer, Design Engineer, Centrifugal Pump Department, Allis-Chalmers Manufacturing Co., Milwaukee, Wisc.

3:30 P.M. *Central Station Power Plants* — Grand Ballroom. Chairman: Ben G. Elliott, Chairman, Department of Mechanical Engineering, University of Wisconsin, Madison, Wisc.

(a) Design Features of the Oak Creek Station. O. J. Stallkamp, Assistant Chief Designer, Wisconsin Electric Power Co.

(b) The Joppa Steam Electric Station. Ralph Moody, Executive Vice President, Union Electric Co. of Missouri, and Vice President and Director of Electric Energy, Inc., St. Louis, Mo.

3:30 P.M. *Magnetic Amplifiers and Servo Mechanisms for Power Control* — Crystal Room. Chairman: Alva J. Ward, Sales Manager, S & C Electric Company, Chicago.

(a) Magnetic Amplifiers for Power Control. E. L. Harder, Consulting Transmission Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

(b) Servo Mechanisms in the Power Industry. M. A. Edwards, Manager of Engineering, General Electric Laboratories, Schenectady, N. Y.

6:45 P.M. *All-Engineers Dinner* — Grand Ballroom. Toastmaster: James J. Nance, President, Hotpoint, Inc., Chicago. Speaker: Leland I. Doan, President, Dow Chemical Co., Midland, Mich.

Friday, March 28, 1952

9:00 A.M. *High Voltage Equipment* — Grand Ballroom. Sponsored by Power Group, Chicago Section, AIEE Chairman: T. H. McGreer, Central Station Engineer, Westinghouse Electric Corp., Chicago.

(a) Testing, Rating and Application of High Power High Voltage Circuit Breakers. C. L. Killgore, Assistant to Chief Designing Engineer and Byron Evans, Assistant Head, Power System Technical Section, Bureau of Reclamation, Denver, Colo.

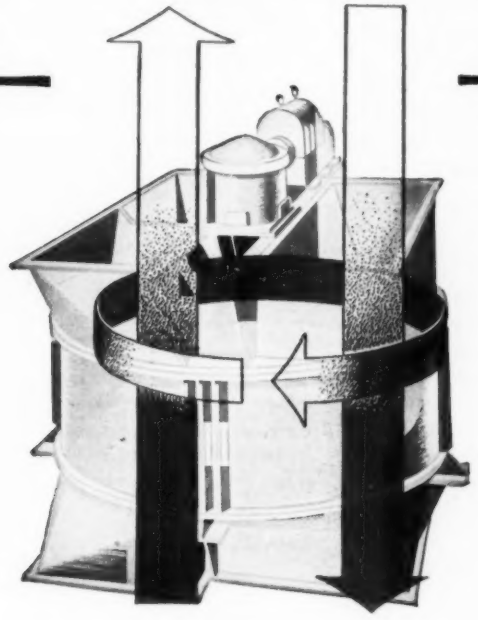
(b) Lightning Arrester Protection of Substations. E. R. Whitehead, Director, Department of Electrical Engineering, Illinois Institute of Technology.

9:00 A.M. *Water Technology Session No. 2. Corrosion in Central Stations*

more than 285,000,000 lb/hr of post-war steam generating capacity

equipped with *Ljungstrom*

AIR PREHEATERS



Here indeed is impressive evidence of the wide acceptance of the Ljungstrom air preheater. Since the war the total capacity of steam generating units equipped with Ljungstrom air preheaters, installed, under construction or on order in industrial and utility plants throughout the country comes to well over 285,000,000 pounds of steam per hour.

The reasons for the steadily increasing preference for the Ljungstrom air preheater are simple enough. The continuous regenerative counterflow principle assures maximum heat transfer with minimum weight and size. Flexible and compact, it may be used in a wide range of applications. Its proven reliability and low maintenance eliminate costly shutdowns.

If you are planning to build a new plant or modernize an old one, investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid in effecting the most economic heat recovery from flue gases.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER CORPORATION

60 EAST 42d STREET • NEW YORK 17, NEW YORK

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY..

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS...

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME...

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. For information on how you can solve your slime problems, contact your nearest W&T Representative or write to:

CD-35a

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

— Louis XVI room.

(a) Water Tube Corrosion in British Power Stations. E. W. F. Gillham and R. S. Rees, British Electricity Authority, London, England.
(b) To be announced.

9:00 A.M.–12:00 Noon. *Symposium on Diesel Power Plants* — Crystal Room.

(a) Study of Operating Costs of Large Slow-Speed Diesel Engines Versus Gas Turbines. J. Byron Sims, Sup't. of Public Works, Grand Haven, Mich.
(b) and (c) To be announced

10:30 A.M. *Utilization of Electric Power* — Grand Ballroom.

(a) Load Research as a Guide for Selective Selling. C. M. Turner, Vice President, The Cincinnati Gas and Electric Co., Cincinnati, Ohio, and Chairman, Load Research Committee, AEIC.
(b) Selective Selling Based on Load Research, George E. Whitwell, Vice President, Philadelphia Electric Co., Philadelphia, Pa.

10:30 A.M. *Fuels* — Louis XVI Room. Chairman: G. Ross Henninger, Assistant Director, Engineering Extension Service, Iowa State College, Ames, Iowa.

(a) The Place of Lignite as a Fuel for the Middle West. Alex Burr, Director of Research, North Dakota Research Foundation and Chief of the Fuels Technology Division, Region V, U. S. Bureau of Mines, Bismark, N. D.
(b) The Processing of Coal. A. D. Singh, Director and President, Singh Co., Chicago.

12:15 P.M. *American Power Conference Luncheon* — Grand Ballroom. Sponsored by the Western Society of Engineers, Donald N. Becker, President. Presiding: Donald N. Becker, President, Western Society of Engineers, Chicago. Speaker: William J. Grede, President, National Association of Manufacturers.

2:00 P.M.–5:00 P.M. *Gas Turbine* — Grand Ballroom. Chairman: J. T. Rettaliata, President; Illinois Institute of Technology, Chicago.

(a) Gas Turbine Power Plant Designs. T. J. Putz, Manager, Locomotive and Gas Turbine Engineering Division, Westinghouse Electric Corp., Philadelphia, Pa.
(b) Operating Experiences with Gas Turbines. Paul R. Sidler, President, Brown Boveri Corp., New York.
(c) Progress Report on the Coal Fired Gas Turbine Locomotive. J. I. Yellott, Director of Research, Locomotive Development Committee, Bituminous Coal Research, Inc., Dunkirk, N. Y.

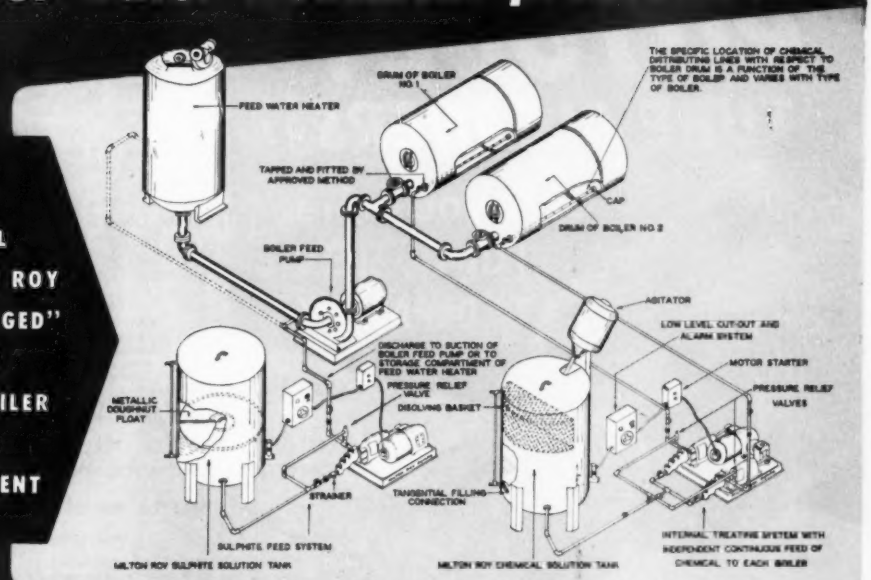
2:00 P.M. *Water Technology Session No. 3. Corrosion Problems* — Louis XVI.

(a) Protecting Heating Units in Condensate Lines Against Corrosion. G. A. Mierendorf, Sup't. of Power Plants, A. O. Smith Corp., Milwaukee, Wisc.
(b) Control and Prevention of Iron Oxide Deposits in High Pressure Boilers. R. C. Ulmer, Technical Director, Power Chemicals Division, E. F. Drew and Co., New York.

2:00 P.M.–5:00 P.M. *Symposium on A-C Network Analyzers* — Crystal Room. Chairman: Eric T. B. Gross, Professor of Electrical Engineer-

Here's a sure "system" for beating boiler water treatment problems!

IT'S A TYPICAL MILTON ROY "PACKAGED" SYSTEM FOR BOILER WATER TREATMENT


FEED WATER HEATER
DRUM OF BOILER NO. 1
THE SPECIFIC LOCATION OF CHEMICAL DISTRIBUTING LINES WITH RESPECT TO BOILER DRUM IS A FUNCTION OF THE TYPE OF BOILER AND VARIES WITH TYPE OF BOILER.
TAPPED AND FITTED BY APPROVED METHOD
CAP
DRUM OF BOILER NO. 2
BOILER FEED PUMP
AGITATOR
LOW LEVEL CUT-OUT AND ALARM SYSTEM
DISCHARGE TO SUCTION OF BOILER FEED PUMP OR TO STORAGE COMPARTMENT OF FEED WATER HEATER
MOTOR STARTER
PRESSURE RELIEF VALVE
PRESSURE RELIEF VALVES
METALLIC DOUGHNUT FLOAT
DISSOLVING BASKET
STRAINER
TANGENTIAL FILLING CONNECTION
SULPHITE FEED SYSTEM
INTERNAL TREATING SYSTEM WITH INDEPENDENT CONTINUOUS FEED OF CHEMICAL TO EACH BOILER
MILTON ROY SULPHITE SOLUTION TANK
MILTON ROY CHEMICAL SOLUTION TANK

IN these days of insistence on production efficiency, engineers turn to Milton Roy for *dependable* continuous treatment of boiler feed water. Here are just a few reasons why:

Milton Roy automatic "packaged" systems are engineered by specialists in Controlled Volume Pumping. The use of Milton Roy Controlled Volume Pumps in these systems is positive assurance of precision control and metering of chemicals at any pressure requirement. The patented non-clogging liquid end step-valve design of these pumps contributes materially to the efficiency of the system. Power plants and public utilities, both large and small, attest the record of uninterrupted service supplied by Milton Roy pumps and equipment.

These packaged systems are custom engineered to specifications. All necessary accessory equipment is supplied—solution tanks, covers, gage glasses, low-level cut-outs and alarms, motor starters and agitators as needed. Obvious benefits result from using one source of supply.

Milton Roy supplies systems for internal and external water treatment to handle all treating chemicals to meet all capacity and pressure requirements. Write to our engineers for complete information.

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1320 EAST MERMAID LANE, PHILADELPHIA 18, PA.

MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

From Head to Hose

ROTOJET®

TUBE CLEANERS

Give you more

POWER, SPEED

DURABILITY

★ Rotojet Tube Cleaners, from head to hose, are tailored to meet individual requirements.

★ Roto Swing-frame Heads, pioneered by us, are the most durable and efficient for finish cleaning. A wide variety of heads and brushes with individually replaceable wearing parts reduce costs materially.

★ Roto Universal Joints combine strength with special protection against wear and vibration.

★ Rotojet Motors operate with air, steam or water. They clean tubes ⅛" ID up to large pipes faster than any cleaner we ever made. The rugged, efficient Rotojet Motor has only two moving parts.

★ Special Roto Operating Hose withstands abusive twisting, pulling, and abrasion.

★ From head to hose Rotojet gives you the best combination for a fast, thorough job.

SEND FOR NEW ROTOJET BULLETIN

ROTOJET Water-driven Motor Model 321 with swing-frame head and universal joint for 2½"-3" I.D. curved tubes.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue Newark 1, N. J.

ing, Illinois Institute of Technology, Chicago.

SPEAKERS:

(a) E. A. Daldini, Engineering Assistant, The Detroit Edison Co., Detroit, Mich.
(b) M. A. Faucett, Professor of Electrical Engineering, University of Illinois, Urbana, Ill.
(c) F. H. Howell, Network Analyzer Engineer, American Gas and Electric Service Corp., New York.
(d) A. J. Krupy, Senior Engineer, System Planning Division, Commonwealth Edison Co., Chicago.
(e) E. B. Phillips, Director, Network Analyzer Studies, University of Kansas, Lawrence, Kans.
(f) James E. Van Ness, Electrical Engineering Department, Northwestern University, Evanston, Ill.

2:00 P.M. *Water Technology Session No. 4 — Power Plant Water Problems.* Louis XVI Room. Chairman: W. W. Tomes, Vice President and General Manager, Cochrane Engineering Corp., Chicago.

(a) The Chemical Treatment of an Evaporator at West Springfield Station. A. R. Haskins, Jr., Mechanical Equipment Engineer, Western Massachusetts Electric Co., Springfield, Mass.
(b) Feedwater Treatment at Illinois State Institutions. R. W. Lane, Chemist, State Water Survey Division, State of Illinois, Springfield, Ill.

HELPFUL BULLETINS

(*Continued from page 38*)

dations and illustrations of "V" metal insert packings, metallic valve stem, plastic core metallic face, high temperature aluminum and braided copper packings. Also gives sizes, packaging information and weights. Packing Div., Raybestos-Manhattan, Inc.

COOLING, AIR CONDITIONING

127 Cooling Coil Developments — Latest developments in extended surface cooling coils, for use with direct expansion refrigerants and chilled water in air conditioning or process applications, are summarized in 72-pp revised Bulletin DS-365. Included in descriptive material are a new coil for use where the quantity of water is restricted, and a redesigned coil that can be drained where danger of freezing exists. Special consideration is given to coils designed for gas cooling, butane vaporizing, transformer oil cooling, generator cooling and condensing of gaseous refrigerants. Booklet provides performance data tables, selection instruction, specifications to enable selection of proper design for any air conditioning, industrial or process application. The Trane Co.

128 Air Conditioning Cabinets — Engineering Bulletin 3703A, 40 pp, describes and illustrates manufacturer's Model G cabinets, central units available in both horizontal and vertical models, providing 875 to 22,000 cfm and offering combinations for any function or functions of air conditioning. Booklet gives construction details, discusses heating and cooling coils; tells how to select cabinets. Includes size and capacity data for direct expansion and water cooling, steam and hot water heating, also speed and horsepower tables, physical data. Buffalo Forge Co.

129 Cooling Towers Noisy? — Bulletin C-3 describes and illustrates silencing equipment for cooling towers. Lists causes of noise, paths of noise transmission, methods of noise elimination. Pictures silencers in use. Industrial Acoustics Co. Inc.

Precision Built

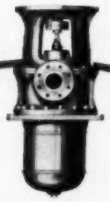
MATHEMATICAL FORMULAE...KNOWLEDGE BORN OF EXPERIENCE AND THE HUMAN EQUATION ARE COMBINED IN THE DESIGN DETAILS...TOP GRADE MATERIALS OF CONSTRUCTION AND PRECISION WORKMANSHIP ARE COMBINED IN THE FABRICATION

to make every

Pacific

A Boiler Feed Pump of Quality

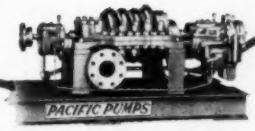
BUT THE POWER OF YOUR GOOD WILL PROVIDES THE CONCLUSIVE EVIDENCE OF THEIR ACCEPTANCE



PACIFIC TYPE WBF

PACIFIC TYPE ABF

PACIFIC TYPE IBF



PACIFIC TYPE JBF

For Central Station, Industrial and Marine Services

THOUSAND KW

YESTERDAY...

The total capacity of all boiler feed pumps built and installed by Pacific during the year 1930 was 15,000 KW. In 1939 it was only 65,000 KW.

The first Pacific boiler feed pump for central station service was built in 1940...the first for marine service in 1944. The total capacity of all Pacific boiler feed pumps built in 1950 was 4.75 million KW.

MILLION KW

TODAY...

the 9.5 million KW capacity in various stages of construction is conclusive evidence of your acceptance of

PACIFIC *Precision Built* BOILER FEED PUMPS

Pacific Pumps inc.

ONE OF THE DRESSER INDUSTRIES — HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York Offices in All Principal Cities

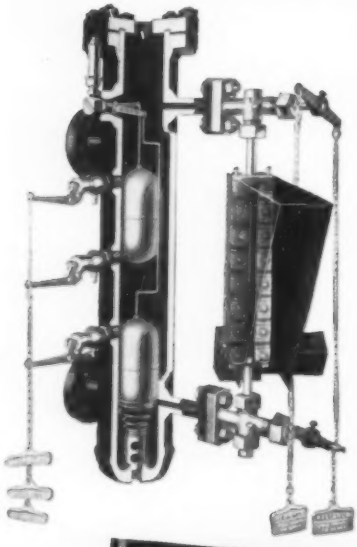
BF-14

Reliance

Safety Water Columns

...your basic guide to

Boiler Water Level Safety



●Keep your power plant from being the subject of a boiler insurance company report. Service without shutdowns from water level accidents can only be assured by constant alertness aided by modern safety devices.

Reliance Water Columns with positive, quick-acting alarms are made for pressures to 900 pounds. They're considered *standard* by leading boiler manufacturers, consulting engineers and government authorities.

For higher pressures, standard and custom-built equipment is available that embodies principles of design and construction perfected by Reliance in 68 years of specializing in this field. Specify Reliance for new or replacement Water Columns.

THE RELIANCE GAUGE COLUMN COMPANY

5902 Carnegie Ave. • Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

130 Heat Transfer Data — Twelve-pp Bulletin PE-8 contains a series of charts and nomographs which greatly simplify calculation of heat transfer requirements. Data is also given for a newly designed cascade type heat exchanger — coolers available in standard complete units to meet various requirements. Utilizing specially constructed Pyrex glass heat exchange tubes, the coolers provide an economical way to cool corrosive liquids. Corning Glass Works.

VALVES

131 Blow-Off Valve — Bulletin 152 contains detailed information and illustrates important construction and operating features of company's rotary disc continuous blow-off valve with 15 calibrated orifices, interchangeable for any required flow to correspond with flow chart provided vith unit. Fuel savings, uniform boiler water concentrations, other advantages stressed. The Uniblow Valve Co.

132 Automatic Control Valves — General Catalog 26 shows various types of automatic control valves for steam and water service. Included are manufacturer's well-known triple-acting non-return valves for protection of boiler and steam lines, altitude control valves to protect against tank overflow, also single-acting non-return types, combined throttle and automatic engine stop valves, electric emergency trip valves, steam and water pressure reducing valves, relief valves, float operated valves, many others. Provides data on operating sequences, construction details, available materials, sizes. Golden-Anderson Valve Specialty Co.

133 Butterfly Valves — Twelve-pp Catalog 1700 covers use of manufacturer's Air-O-Motor diaphragm operators with Continental butterfly valves. Complete specification data is given for both standard and heavy duty pattern valves. A wide selection of diaphragm operators is shown and described. Also included are material specifications, mounting dimensions, maximum pressure ratings and selecting and ordering information. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

FANS, BLOWERS

134 Mechanical Draft Fans — Stressing the heavy-duty construction of fans built for high efficiency at high speed performance, illustrated Catalog 901, 12 pp, describes their design features and discusses in detail their bearings, louver dampers. A single- and double-width arrangement are diagrammed, and some variations of the basic design are pictured. Three power plant installations are described briefly. Dimensions, weights included. Clarage Fan Co.

135 Fans and Blowers — This 12-pp pocket-size catalog lists a wide range of ventilating fans, air circulators, belt driven exhaust fans, floor and window fans, also spray booth fans, pressure and volume blowers in capacities for most industrial applications. Illustrated, includes specifications, prices. Standard Electric Mfg. Co.

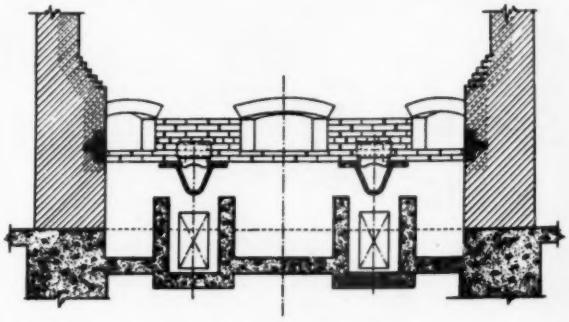
FIRE PREVENTION, SAFETY

136 Fire Fighting Products — Illustrated Portable Catalog CP-7 presents company's line of fire fighting equipment and chemicals. A variety of nozzle types are pictured and described, also applicators, pipe, ball valves, adaptors, related equipment. An around-the-pump proportioner and liquid foam and wetting agents are also covered. Rockwood Sprinkler Co.

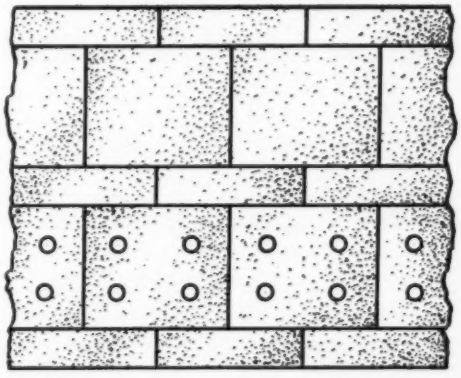
137 Hydraulic Fluid — Here's a 12-pp booklet describing in detail the properties and performance of Pydraul F-9, company's nonflammable-type hydraulic fluid. This fluid, developed primarily for use in hydroelectric turbines, hydraulic presses and similar equipment, has application in operations where a flammable pressure transfer fluid is a hazard. Besides chemical and physical characteristics, booklet reports with charts and pictures on tests showing fluid's fire resistance, lubricity, noncorrosiveness, stability. Monsanto Chemical Co.

THESE BOILER FURNACES

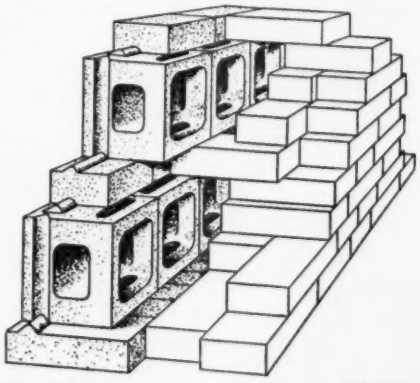
Cost Less to Maintain...



Solid Crystolon Brick Construction



Front View



Back View

Crystolon Air Cooled Block Construction

Because:

NORTON CRYSTOLON* BRICKS OR AIR COOLED BLOCKS at the clinker line, as detailed above, are: (1) so highly refractory that they successfully stand temperatures up to 2900°F; (2) so dense that they effectively resist slag penetration and clinker adhesion; (3) so hard that they are not noticeably affected by abrasion, even that caused by the moving fire bed of stoker-fired furnaces.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

WRITE FOR BULLETIN 862

For all the reasons why Norton Crystolon silicon carbide brick is your best buy for long service and low maintenance cost, consult your nearby Norton representative or write direct for Bulletin 862. Norton Company, 615 New Bond St. Worcester 6, Massachusetts.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

The heart of a Dart — the non-corroding bronze seats — are specially ground by oscillating grinders to give *them* a true bearing surface — and give *you* an ABSOLUTELY LEAKPROOF JOINT.

What's more, Darts assure a drop tight joint without excessive wrenching — and they *stay* tight. You save on maintenance.

Body and nut of a Dart are other quality features that cut your costs. Made of practically indestructible, high-test, air-refined, malleable iron, they can take the toughest wrench "work outs" while protecting the joint. You'll like Dart threads too — full and clean-cut. And remember, Dart is the union you can use *over and over again.* It thrives on work!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

OTHER EQUIPMENT

138 Boiler Settings — Excellent reference material on boiler operation and maintenance is provided in 24-pp "Boiler Settings with Plastic and Castable Refractories." Contains numerous cross-sectional drawings, charts, technical illustrations and other data in the field of plastic and castable refractories and their applications. Also presents information about refractory manufacture, design and installation. The Ramtite Co., Div., The S. Obermayer Co.

139 Pipe Tool Book — Just released is the 1952 edition of company's catalog and data book giving information on pipe and bolt machines, power units, ratchet threaders, reamers and cutters, other power and hand tools. Includes popular "operating guide" section. Fully illustrated with easy-to-grasp drawings, clear technical copy telling how to locate pipe tools. Beaver Pipe Tools, Inc.

140 Anchor Bolts — Sixteen-pp Catalog 4 is an ordering booklet covering a wide range of anchor bolts. Includes screw anchors, extension sleeve anchors, single and double anchor bolt assemblies, eye bolt assemblies, hook bolt assemblies, pipe bolt assemblies, refractory anchors, concrete inserts, also drills and tamping tools. Gives sizes, safe anchorages, weights and prices. Super-Grip Anchor Bolt Co., Inc.

141 Chlorination for Power Plants — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the desliming processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Illustrated with photos of equipment, performance charts, diagrams. Wallace & Tiernan Products, Inc.

CATALOG LIBRARY

(*Continued from page 48*)

218 Lithium Soap Greases — Twelve-pp. Booklet AD3084, on manufacturer's Stanolith greases, explains how they withstand both high temperatures and wet operating conditions. Discusses two grades — one recommended for central dispensing systems, and a heavier grade for compression cups or pressure gun applications. Difficult lubrication jobs successfully handled by Stanolith greases are described and pictured. Standard Oil Co. (Ind.)

219 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel and heating oils, dust control. Examples of increased production and lowered costs resulting from use of this service are cited. Gulf Oil Corp., Gulf Refining Co.

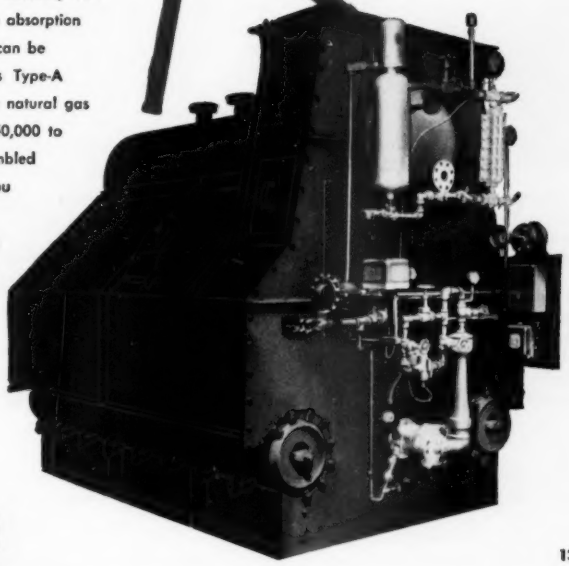
VALVES, TRAPS, PIPING

220 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features. Edward Valves, Inc.

221 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes

high temperatures low pressures with the efficient WICKES type-A dowtherm vaporizer

Wickes Type-A Dowtherm Vaporizer is a compact, efficient radiant heating furnace especially designed for the use of Dowtherm. It is enclosed on both sides by two banks of short, steeply inclined connection tubes that permit operation at maximum temperatures and unusually low pressures without overheating or excessive absorption anywhere in the unit. High temperatures can be accurately and safely controlled. Wickes Type-A Dowtherm Vaporizers, adaptable to oil or natural gas firing, are available in capacities from 750,000 to 20,000,000 B. t. u. per hour—in shop-assembled units up to 6,000,000 B.t.u. per hour. If you are manufacturing petroleum, plastics, paint, food or chemicals or engaged in processing requiring high temperatures, it will pay you to install a Wickes Type-A Dowtherm Vaporizer. Write for descriptive literature or consult your nearest Wickes representative.



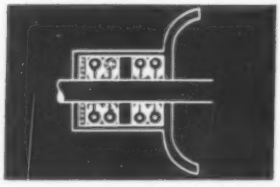
137

WICKES

THE WICKES BOILER COMPANY
DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

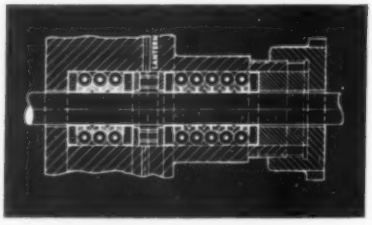
RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Atlanta • Buffalo • Boston • Chicago • Cincinnati • Denver • Detroit • Cleveland • Houston • Indianapolis • Los Angeles • Milwaukee • Memphis • New York City • Pittsburgh • Saginaw • San Francisco • Springfield, Ill. • Portland, Ore. • Tulsa • Washington, D. C. • Greensboro, N. C. • Tampa, Fla.

Chesterton 444



Chesterton 444 is full metallic on rod or shaft. It runs frictionless without usual gland pressure. Why? It's due to E-L-A-S-T-I-C back and *built-in oil seal* in each Metallic ring. These special metal rings are soft enough to machine themselves to rod imperfections. 8 to 10 years uninterrupted service is common with Chesterton 444.

Chesterton 444, formerly Austin-Mason, is the most famous name in refrigeration packing. Easy to install — each ring is cut so it may be opened to fit over rod or shaft. Full directions accompany every set. Unexcelled for Ammonia, Freon, CO_2, steam, brine, air and other liquids and gases.



PACKING Chesterton SERVICE

A. W. CHESTERTON CO.
6 Ashland St., Everett 49, Mass.

Without obligation please send free descriptive folder on Chesterton 444.

Name_____ Company_____

Street_____

City_____ State_____

POE

a section on products for refrigeration service. Fully illustrated, indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

222 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, dimensions; pictures typical installations. Also discusses variations. The Chapman Valve Mfg. Co.

223 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

224 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb. W. H. Nicholson & Co.

225 Valve Specialties — Included in 90-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, stream trap and air vent; liquid level controllers; solenoid valves. Includes capacity charts. Davis Regulator Co.

226 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co.

227 Forged Steel Valves — Form 800-A describes 600-lb forged steel valves for high line pressure and temperature applications. Covers both inside screw and OS&Y union bonnet gate types, giving sizes, prices. The Ohio Injector Co.

229 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure traps sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co

230 Solving Steam Trap Problems — This popular 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install traps and service them. The V. D. Anderson Co.

231 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

232 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

233 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. E. M. Dart Mfg. Co.

235 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Northern Equipment Co.

ELECTRICAL

236 Power Factor Correction — Examples showing basic considerations in the improvement of system power factor are contained in Bulletin 05B7465. Points out advantages of improving plant power factor and advisability of keeping load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

237 Co-ordinated Protection of Motors — The interlinked protection of circuits, motors and personnel is explained in 12-pp Bulletin DB-4673 on high-voltage combination starters. Because almost every 2300/4800 v power system can produce high currents under short-circuit conditions, booklet stresses this interlinked protection, covering three classes of combination motor starters. Westinghouse Electric Corp.

238 Care of A-C Rotating Equipment — To promote intelligent, consistent maintenance of electrical machines, company offers Bulletin 05R7417, a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

PUMPS AND COMPRESSORS

239 Screw Pumps — Bulletin 8204, 18 pp, describes and illustrates Warren-Quimby screw type rotary pumps. Provides sectional and exterior views, installation pictures, dimensions, engineering and selection data. Warren Steam Pump Co., Inc.

240 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

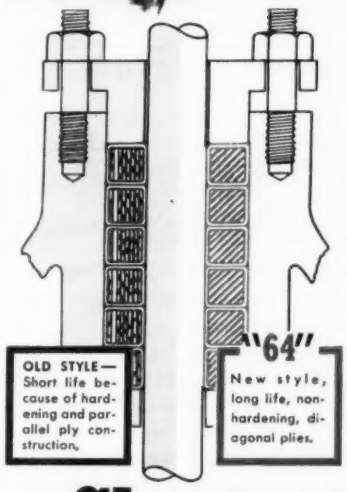
241 Controlled Volume Pumping — Illustrated Bulletin 151, 24 pp, on controlled volume pumping will be of interest to engineers whose plant operations call for pumping a controlled volume of liquid in amounts from 3 ml per hour to 50 gpm. Describes features of company's pumps and includes data for selecting pumps for specific applications, 170 chemicals. Milton Roy Co.

242 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data, vapor pressure tables included. Pacific Pumps, Inc.

243 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. Impellers, diaphragms, bearings and stuffing boxes are described. De Laval Steam Turbine Co.

INSTRUMENTS AND CONTROLS

244 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating in-


OLD STYLE—
Short life because of hardening and parallel ply construction.
"64"
New style, long life, non-hardening, diagonal plies.

Long service against steam demands a packing of resilient construction and non-hardening materials. In Chesterton "64", the resilient asbestos diagonal plies adjust themselves, pressurewise, snugly against the rod; the exclusive binder resists hardening even under superheat. Try Chesterton "64" and you will find it's a long, *long* time, often years, before repacking. Send coupon for free sample.

Chesterton "64"

PACKING Chesterton SERVICE

A. W. CHESTERTON CO., 6 Ashland St., Everett 49, Mass.

☐ Send free cross-section sample of "64".

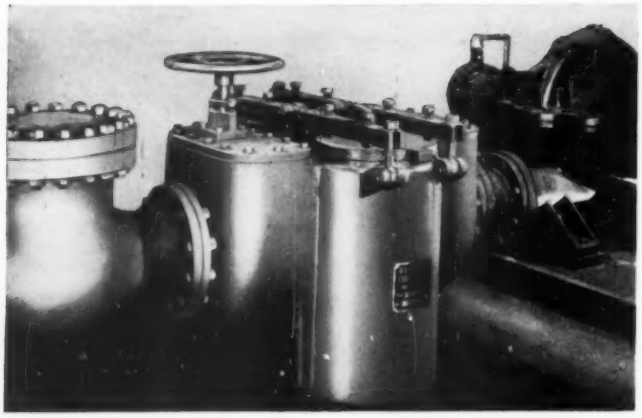
☐ Who is my local distributor?

NAME _____ TITLE _____

COMPANY _____ STREET _____

CITY _____ STATE _____

POE



R-S Duplex Strainer

Cleaned Under Full Flow

THE R-S DUPLEX STRAINER has two large identical basket strainers, either of which can be removed for cleaning without interruption to the flow. Full control is obtained by 2½ turns of the single handwheel.

Valve is in continuous contact with the seat, and cannot become loose or fouled. Operating mechanism is on the downstream side of the strainer, not in the path of flow and in contact with clean strained liquid only.

Designed for minimum pressure drop and low maintenance (only one stuffing box), the R-S Strainer was developed by a well known power plant piping design engineer in order to eliminate the disadvantages of most strainers for heavy industrial service.

R-S Strainers are widely used on house service lines in major generating stations and on fuel oil lines in utility and heavy industrial plants. Available in various types of metal for nearly all liquids in four-inch to 24-inch pipe sizes.

Call your nearest R-S Engineer for further information or write direct.

R-S PRODUCTS CORPORATION
4600 Germantown Avenue
Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

formation and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

245 Putting the Ratio Totalizer to Work — Twelve applications of company's ratio totalizer in automatic control circuits are shown in 8-pp Bulletin 5450. This is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

246 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

247 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

248 Instruments, Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

249 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains principle of operation. The Reliance Gauge Column Co.

251 Temperature Regulators — Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controlling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Eight instruments are presented. Fully illustrated, includes selection and application chart. Foster Engineering Co.

252 For Determining Steam Consumption — Bulletin R-513 explains design, construction, installation and operation of manufacturer's rotary condensate meter, an economical means of determining steam consumption where all condensate can be captured. Includes size, dimension and weight table, simplified piping diagrams for both gravity, vacuum systems. American District Steam Co., Inc.

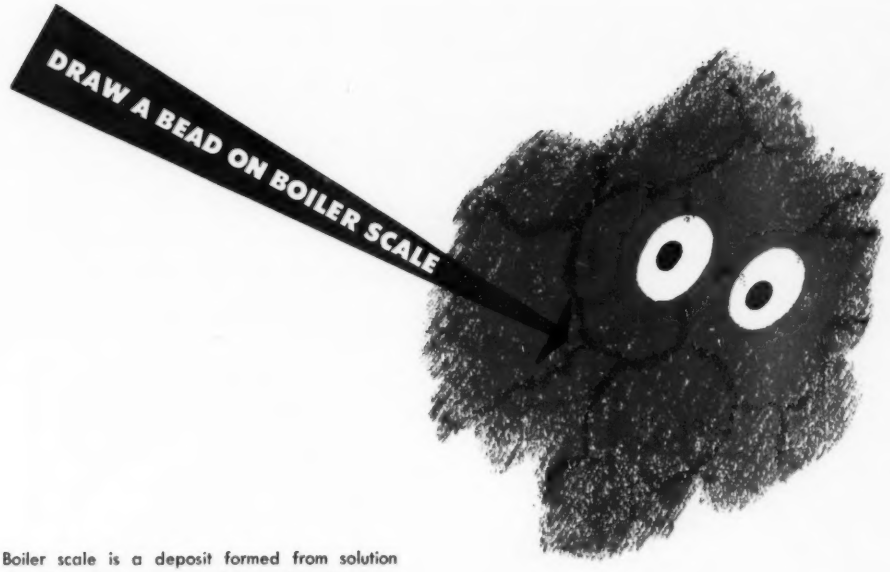
253 Pressure Regulator — Bulletin 1-B, 8-pp discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co.

PACKINGS

255 Pump Packings — Packings for reciprocating and centrifugal pumps are described in this folder. Covers packings for practically all services. Johns-Manville.

256 Manual on Packings — Containing 84 pp. of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co.

257 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical



Boiler scale is a deposit formed from solution directly in place upon a confining surface. It is crystalline and dense and usually retains its physical shape when removed. (Ref. ASTM D 887, D 933).

Use DREW POWER CHEMICALS

No boiler is exempt from scale under present day operating conditions. Scale results in tube failure, plant shut-down, trouble and inconvenience. It's the duty of every good water treatment company to recognize and solve this problem.

Draw a bead on boiler scale! Call in the Drew Engineer. The water samples and operating data that he obtains in your plant will be thoroughly analyzed in the Drew Laboratories, and you'll be given specific recommendations for corrective or preventive treatment. And you'll receive frequent and continous service, too.

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew engineer or write for information.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS

Nationwide Service in Boiler Water and Cooling Water Conditioning

DREW PRODUCTS

applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

258 Metallic Packing — An elastic metallic packing for compressors, engines and pumps is described as to construction and advantages in this illustrated bulletin. Explains easy installation of the packing, illustrates installations. A. W. Chesterton Co.

259 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

FANS, BLOWERS

260 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements. The Green Fuel Economizer Co., Inc.

261 Axial Flow Blowers — In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and dimensional data, operating range and specifications on both types. L. J. Wing Mfg. Co.

BOILERS AND AUXILIARIES

262 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Explains operation, features. Combustion Engineering-Superheater, Inc.

263 Packaged Generators — Bulletin SB-38 presents company's Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Erie City Iron Works.

264 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

265 Tube Expanders — Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators, other equipment. Thomas C. Wilson, Inc.

266 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

267 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

269 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

270 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, stream generators and other applications. Discusses heat transfer properties, high temperature use. Also discusses prevention of galvanic corrosion. Bridgeport Brass Co.

COAL AND ASH HANDLING

272 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

273 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

274 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's RotoGrate stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. More than 20 such installations are described, illustrated. Detroit Stoker Co.

275 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

276 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of ar-

RODA

High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK

The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE

Roda and Stonega from Wise County, Va.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL

High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER

Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO

High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE

Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Properly Applied.

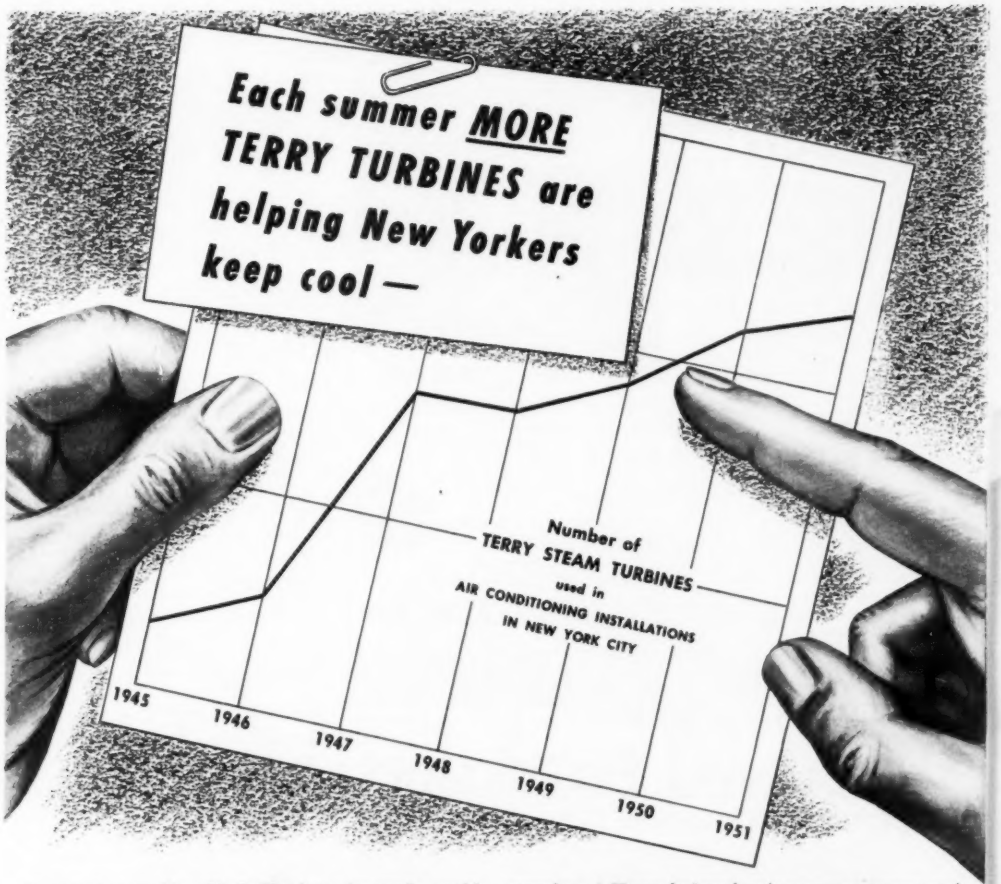
General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

CABLE ADDRESS, GENCO

BRANCHES:

BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH



In recent years, New York City has witnessed a rapid gain in the number of air-conditioning installations providing comfort cooling by means of steam. And, as the accompanying chart shows, TERRY STEAM TURBINES have figured prominently in this relatively recent development.

TERRY TURBINES make an ideal prime mover for driving the refrigerating compressor. They respond automatically to the temperature requirements, and will cut back to as little as 15 percent of rating without attention. A Terry-designed unit assures economy and ease of operation.

Before you make a decision on your air-conditioning installation, why not call in a Terry representative? He will be glad to explain the benefits of *comfort cooling by steam.*

PARTIAL LIST OF TERRY TURBINE INSTALLATIONS IN NEW YORK CITY
Best & Co. • Bloomingdale Bros. • Book-of-the-Month Club Carbide & Carbon Building • Federal Reserve Bank • Lord & Taylor • Macy's New York • Madison Square Garden James McCreery & Co. • Mutual Life Insurance • Port Authority Bus Terminal • The 260 Madison Avenue Building

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

For Low Cost, Dependable

Cooling of Engine Jacket Water and Lubricating Oil

- Lower Installed Cost
- Higher Efficiency
- Fewer Parts to Assemble
- Lower Maintenance Costs
- Lower Operating Costs
- Many Industrial Uses

Write for Bulletin No. 11.0.080

*Registered Trade Name

Cooling Towers
Gas & Air Treating
Specialized Heat Exchangers

Products of QUALITY Specialized Process EQUIPMENT

J.F. Pritchard & Co.
EQUIPMENT DIVISION
Dept. 257 — 908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

Paracoil EVAPORATORS

for STATION HEAT BALANCE or FRESH WATER SUPPLY

Shop View of SALT AND FRESH WATER EVAPORATORS built by PARACOIL for San Juan Steam Electric Station, Porto Rico Water Resources Authority, San Juan, Porto Rico. Jackson & Moreland, Boston, Mass., Consulting Engineers

HERE'S A JOB WE'VE BUILT FOR SAN JUAN, P. R.

Wherever pure water is needed for boiler feed makeup, process work or general plant operation, a PARACOIL EVAPORATOR is a proven, time-tested means of handling any kind of initial raw water—salt or otherwise.

They are ruggedly built—dependable—and easily maintained. Specific requirements dictate the design. Our years of experience in building units of this type—and other power plant apparatus—assures you of the correct solution to your problem. *We invite your inquiry.*

DAVIS ENGINEERING CORPORATION
1062 East Grand Street, Elizabeth 4, New Jersey
30 Rockefeller Plaza, New York 20, New York

rangements under specific conditions, diagrams of arrangements included. Beaumont Birch Co.

278 Fly Ash Elimination — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

COOLING

280 Heat Exchangers — Bulletin 11.0-080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

281 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co.

282 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

283 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

284 Spray Nozzle Systems — Recooling spray nozzle systems for use in plants operating condensers or using large quantities of water for cooling, are covered in 8-pp Bulletin 6A-SP. It details design, application, construction, and operation of spray nozzles, and diagrams typical spray pond arrangements. Sizes, dimensions, capacities, and spray nozzle patterns are included in tabular form. Includes cooling performance curves for various temperature ranges. Schutte and Koerting Co.

COMMUNICATIONS

285 Civil Defense Communications — Form G93-122, 12 pp, pictures typical communications systems now in use which can be coordinated into a dependable emergency communications network in any community. Describes company's technical advisory service for civil defense radio communications and lists district representatives available to analyze existing systems and form them into a single emergency network. Electronics Dept., General Electric Co.

286 Power Plant Intercom System — A communication system custom tailored to individual plant conditions and designed for two-way conversation over microphones and receivers, as well as paging, is described in this 25-pp booklet. Text tells how system is easily installed and is adapted to different noise levels of a power plant. Photos show installations of paging equipment. Gai-Tronics, Inc.

CONDENSERS

287 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning downtime and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

289 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Dis-

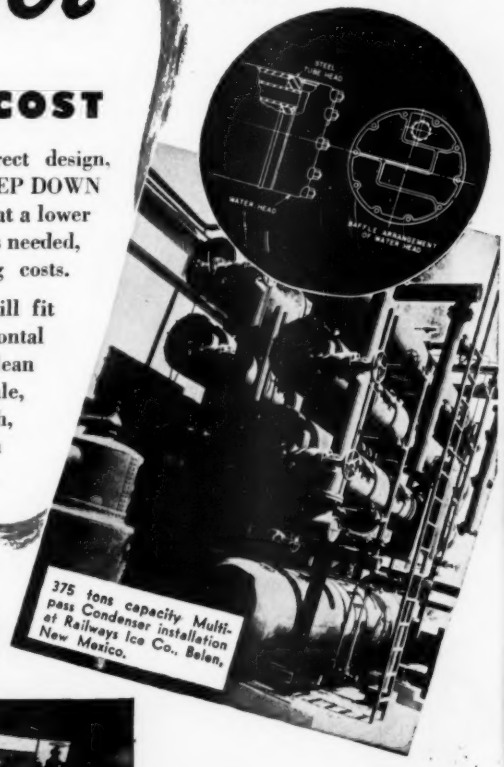
$ave Power
and
REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

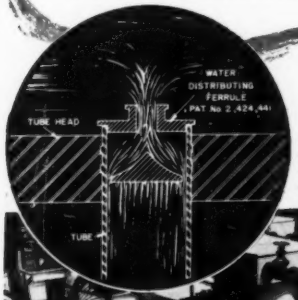
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

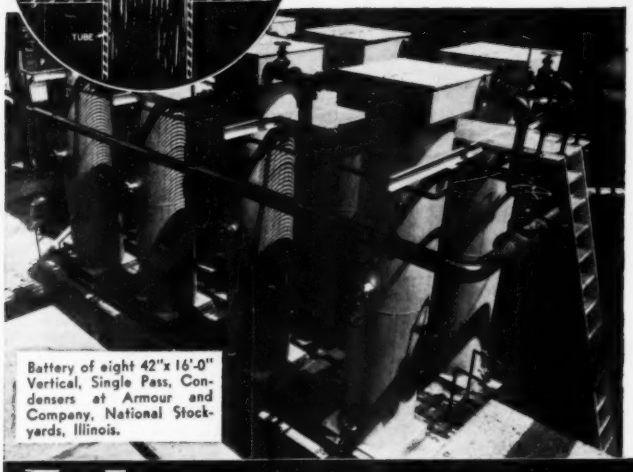


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

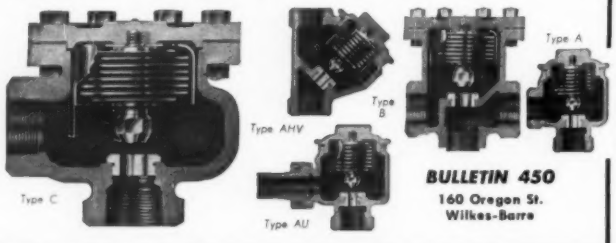
HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

Nicholson Traps Help

CUT STEAM COST $500,000 A YEAR

At one of the nation's large processing plants a campaign to promote economical steam use by improving heat transfer efficiency has resulted in a yearly saving of $500,000. Credit for a fair portion of this is given to improved steam trapping, which resulted from the installation of Nicholson thermostatic traps. To see why an increasing number of leading plants are standardizing on Nicholsons for positive drainage and faster heat transfer, send for Bulletin 450.



BULLETIN 450
160 Oregon St.
Wilkes-Barre

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

CONTROL SCALE AND CORROSION

in BOILERS, STEAM and CONDENSATE LINES, WATER JACKETS, CONDENSERS — Wherever Water Is Used

Now, more than ever before, it is necessary to increase the efficiency and life of equipment by maintaining scale-and-corrosion-free water-side surfaces. Let experienced Wright Chemical Engineers check the requirements for water-conditioning chemicals to solve your problems.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

GENERAL OFFICE AND LABORATORY
619 West Lake Street, Chicago 6, Illinois

OFFICES IN PRINCIPAL CITIES

Sole Distributor of Nelson Chemical Proportioning Pumps

cusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Foster Wheeler Corp.

290 Steam Condensers — Bulletin 102, 24 pp, presents manufacturer's steam condensers and includes photos of typical installations as well as engineering data, discussion of air removal equipment, and chapter on condenser maintenance. Company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages are also described. Condenser Service & Engineering Co., Inc.

TURBINES, GENERATORS

292 Multi-Stage Turbines — Six-pp Bulletin S-147 describes two of company's smaller-frame multi-stage turbines, both of the impulse type. Construction details are illustrated and described in detail. The Terry Steam Turbine Co.

293 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co.

REFRACTORIES, INSULATION

294 Refractory Brick — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also describes a fused aluminum brick of high refractoriness. Fully illustrated. Norton Co.

295 Incombustible Material — "The Story of Kaylo," 24 pp, describes company's new basic material, an hydrous calcium silicate product, covering some of the many uses for this incombustible material in construction and industrial fields. Tells how product was developed, describes its properties, tells densities available for thermal, insulating and structural applications; illustrates available forms. Kaylo Div., Owens-Illinois Glass Co.

OTHER EQUIPMENT

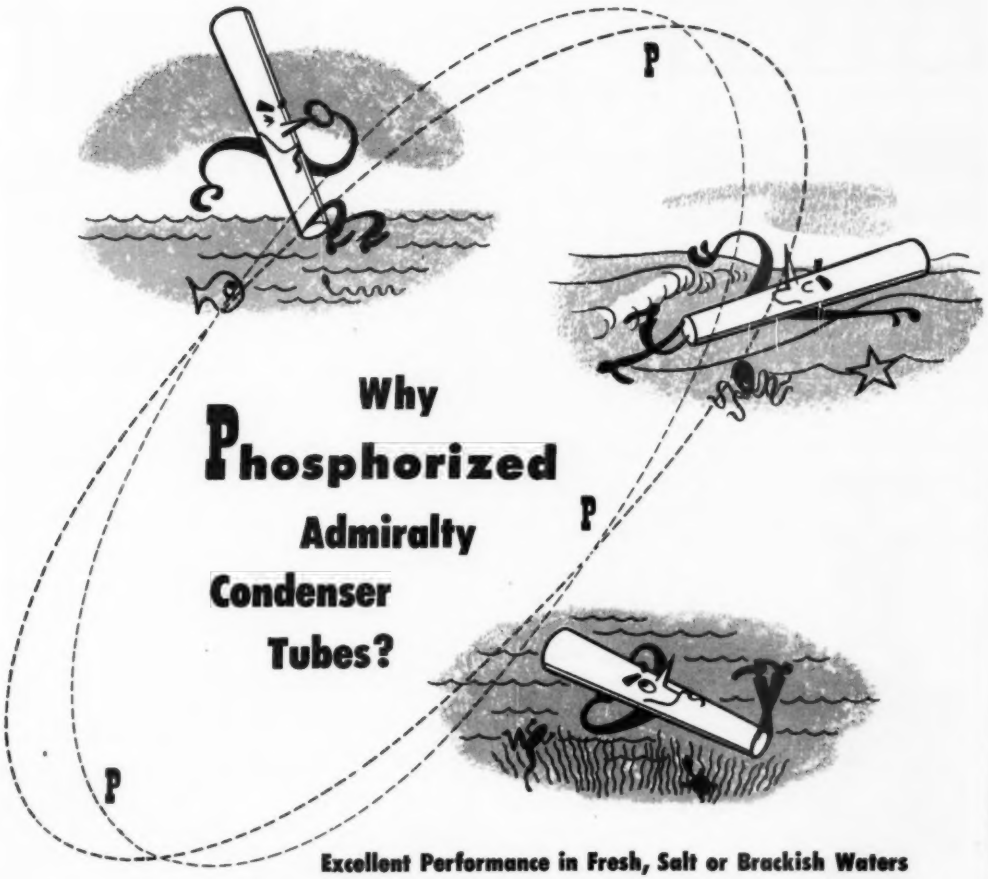
296 Screwdriver Handbook — Besides providing full ordering information, 32-pp Catalog SD-551 serves as a reference encyclopedia on screwdrivers, nutdriver kits and other hand tools. Book is profusely illustrated in color and punched for filing in binder. Includes a handy screw and screwdriver reference chart. Vaco Products Co.

297 Refrigerant Gas Purgers — How air and other non-condensables get into refrigeration systems, adverse effect of this on operating costs and efficiency, and how company's forged steel purger works to prevent this are covered in 8-pp Bulletin 192. Includes installation data, specifications and prices. Armstrong Machine Works.

298 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Included scales of total heat losses of various types of coal, fuel oils and gas. The Hays Corp.

299 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp.

300 Fundamentals of Hydraulics — Technical Bulletin B-4, 44-pp covers hydraulic systems, maintenance trouble-



Why Phosphorized Admiralty Condenser Tubes?

Excellent Performance in Fresh, Salt or Brackish Waters

In order to assure *uniform chemical composition* and *inherent soundness*, Scovill produces Phosphorized Admiralty tubes by its continuous billet-casting process which consistently maintains the optimum amount of phosphorus. Adding as little as 0.02% Phosphorus to Admiralty also gives maximum resistance to dezincification while retaining all the other desirable properties of this alloy.

Scovill's 40-page Condenser Tube Booklet is available to users who request it on their business letterhead. Scovill Manufacturing Company, 15 Mill Street, Waterbury 20, Connecticut.

Only Scovill Phosphorized Admiralty Has All These Advantages . . .

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- Excellent performance in fresh, salt or brackish waters
- High resistance to steam and condensate
- Required heat transfer characteristics
- Superior resistance to general corrosion
- Good resistance to velocities under 7 fps

SCOVILL

A PRODUCT OF SCOVILL

SCOVILL CONDENSER TUBES

"You can't buy better brass"

ATLAS

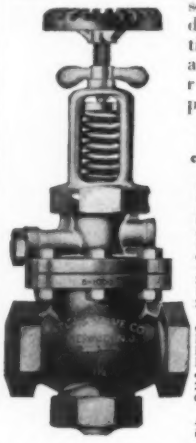
STELLITED

STEAM REDUCING VALVES

Type "B"

ATLAS TYPE "B," always a remarkable performer, is now a *much better* performer because it is STELLITED. The Pilot Valve is made entirely of that famous metal. The seat is STELLITE faced.

Try a Type "B" and you will find that it is unequaled for a service that demands tight seating and uniform reduced pressure.



For Bulletin 1-A, use the coupon below

Here we show Fig. 112 of Bulletin No. 1-A (Ask for a copy) for 300 lb. steam service. All Bronze—Screwed or Flanged Ends—Pilot Operated. Sizes: ½", ¾", 1", 1¼", 1½", 2".

For 250 lb. service we offer Fig. 114, Iron Body—Flanged Ends—Pilot operated. Sizes: 2½", 3", 4", 5", 6", 8".

And for 400 and 600 lb. service see page 10 of Bulletin 1-A.

These valves are for temperatures to 900° F. Steel Body—Nitralloy Piston and Stainless Steel Piston Chamber—Flanged Ends—Pilot Operated. Sizes: ½", ¾", 1", 1¼", 1½", 2", 2½", 3", 4".

Type "B" is simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm and unscrewing pilot valve seat.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

293 SOUTH ST. NEWARK 5, N. J.

Represented in Principal Cities

☐ Without obligation, please send me the ATLAS Regulating Valve Bulletin No. 1-A. Also please send complete information on the following ATLAS products:

☐ Damper Regulators	☐ Pump Governors
☐ Temperature Regulators	☐ Oil Control Cocks
☐ Exhaust Control Systems	☐ Humidity Controllers
☐ Pressure Regulators	☐ Thermostats
☐ Campbell Boiler Feed Water Regulator	☐ Balanced Valves
	☐ Control Valves

Name .....

Firm .....

Address .....

shooting and selection of proper fluids. Besides offering reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators. It features phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Sun Oil Co.

301 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp.

302 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

303 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Tells how tests determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

304 Bibliography on Nickel Alloys — Sixteen-pp List A covers company's technical papers and commercial publications available on nickel alloy steels, stainless steels, nickel cast irons, nickel brasses and bronzes, and nickel plating, and their uses. The International Nickel Co., Inc.

305 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

306 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feed-water system, condensate returns, flushing. % Proportioneers, Inc. %

307 Transmission Belting — Catalog M-9922, 28 pp, gives design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, and service factors included. United States Rubber Co.

308 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances to assure longer life and reduce maintenance and replacement costs. Includes useful table of estimating data. Revere Copper and Brass, Inc.

309 Plus Protection — Vol. 2, No. 2 of the Magnesium Anode is a 2-pp discussion of the value of supplemental cathodic protection for coated pipelines, using magnesium anodes as the source of current. Dowell, Inc.

310 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Reasons for deciding on a demineralizing plant are explained, together with studies of demineralizing systems and cation and anion exchangers from which selection was made. Equipment installed and operating results are explained. Graver Water Conditioning Co.

BELMONT

SHEET PACKINGS

ANSWER YOUR NEEDS...

Ever have a packing failure? Then you don't have to be told the high cost of unscheduled maintenance and interrupted service. Knowing the importance of tight, uniformly dependable seals, why not investigate the packings whose performance has identified them with better sealing—LONGER . . . . Belmont's scientifically formulated and controlled sheet packings.

Standard items are offered in sheets or rolls . . . compressed asbestos, asbestos metallic, rubber sheets in all durometer hardnesses including natural rubber and oil resistant synthetics, cloth inserted, vegetable fibre and a variety of other materials and combinations. Belmont Sheet Packings and Gasket Cutters are sold nationally through distributors. Call yours for service or, where technical assistance is required, write direct.

Catalog #40 Available

A portable tool for cutting 1⅛" dia. to 19" dia. circular gaskets from all kinds of soft sheet packings. Rigid and simple to operate. Larger sizes only require cutter bar replacement.

for Steam • Water • Oil • Gas • Air Acids • Alkalies • Ammonia

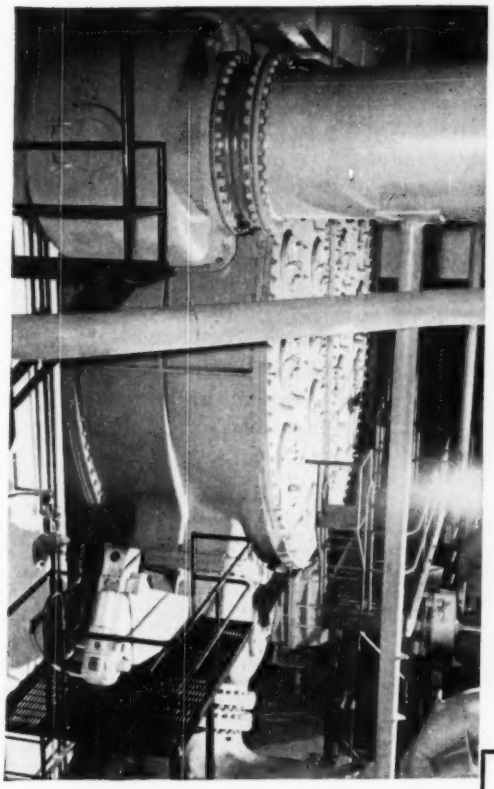
THE BELMONT PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pennsylvania

Rings • Spirals • Coils • Reels Spools • Sheets • Gaskets

There's a Belmont Packing for every service

"SELF-CLEANING" CONDENSER

Eliminates 2 to 3 HOURS Daily Down-time



At Plant Atkinson, Harryat, Georgia, the Georgia Power Company draws circulating water from the Chattahoochee River. The inevitable sand, gravel, twigs and leaves used to clog condenser tubes and tube sheets in a matter of hours. Before the installation of a C. H. Wheeler Reverse Flow "Self-Cleaning" Condenser, it was a two- to three-hour job every day to remove anywhere from ½ to 2 yards of debris by hand. During this time, it was necessary to drop the load on the turbine to about half in order to operate against excessive back pressure.

Since September 5, 1949, when a C. H. Wheeler "Self-Cleaning" Condenser was installed, there hasn't been a single shut-down for cleaning. The Reverse Flow mechanism works flawlessly 24 hours a day, with 70,000 gallons per minute of river water passing through. The only cleaning is done by means of the electrically operated valves that reverse the flow of water through the condenser without interfering in any way with plant operation. This is done as often as necessary in a matter of minutes.

Through eliminating down-time for condenser cleaning, approximately *one month* of full capacity operation is added to the service of one of the four 60,000 KW turbo-generators in this 240,000 KW plant.

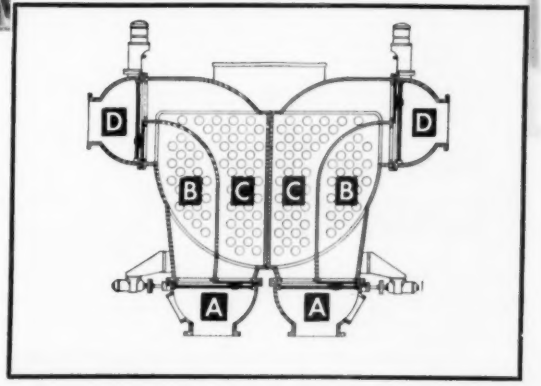
You, too, can benefit by C. H. Wheeler Engineering. Whether or not you need the self-cleaning Reverse Flow feature, it will pay you to "Investigate C. H. Wheeler Condensers before you Invest."

HERE'S HOW THE "REVERSE FLOW" PRINCIPLE WORKS ⟹

Both halves of this Dual Bank Condenser work the same but independently of each other.

Left Side: Water enters divided water box at valve chamber D, with upper port open. It flows through pass C to end of condenser, back through pass B and out through left port of A.

Right Side: Flow is reversed: Valves at inlet D and discharge A are changed to permit water to flow through B and back through C in the opposite direction, then out through lower port of A.



C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. WHEELER MANUFACTURING CO., 1802 SEDGLEY AVE., PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

Discarding condensate because of OIL?

If you are throwing away valuable condensate rather than risk its return to the boiler because of oil contamination, filtration with Sorbo-Cel may be the answer to your problem.

Low in Cost

This specially processed diatomaceous silica powder provides a simple, economical method of removing emulsified oil from water and thereby obtaining an oil-free condensate for boiler feed or other use. Total cost ranges from only 1¢ to 3¢ per 1000 gallons of water filtered.

How it works

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through a pressure filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through.

Does complete job

Sorbo-Cel does a complete job of oil removal. In addition, it removes other suspended matter such as rust, scale, clay and precipitates. And its action is so efficient that large volumes of water can be filtered in a relatively short time.

A bulletin that gives further facts about this low-cost way to remove oil from water is available on request. Just use the coupon below.

JM

Johns-Manville SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

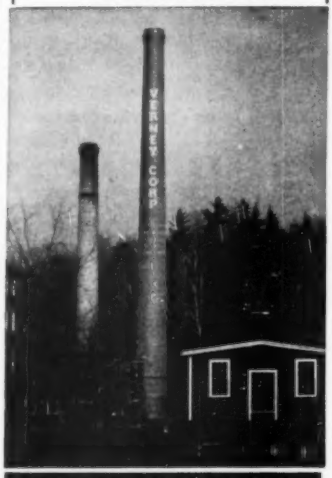
Company_____

Address_____

City_____ State_____

PE-8

Consult Us For:
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS



AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES:
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • RICHMOND, VA. • RALEIGH, N. C.

CLASSIFIED ADVERTISING

EQUIPMENT FOR SALE

WESTINGHOUSE CLASS 4350 Two-Unit Synchronous Motor Generator consisting of 150 KW DC Generator 250 Volt, 600 Amp and 220 HP, 440 Volt, 285 Amp, 60 Cycle, 1200 RPM Motor on common bed plate, complete with all instruments, switches, controls and four panel switchboard. Good mechanical and electrical condition. Immediate possession. La Crosse Rubber Mills Company, P.O. Box 852, La Crosse, Wisconsin.

300 5-10 Amp 110 Volt Meters
Write Henry F. Beisner, Supt.
Municipal Utilities
Cedar Falls, Iowa

1 — Chicago Pneumatic Tool Company Air Compressor — 1200 cu ft free air per min at 125 psi, Engine Type — Skinner double seat poppet valve for 160 lb steam pressure operating condensing or 5 lb back pressure, complete with barometric condenser and auxiliaries. While installed in 1923 this unit has had less than 17,000 operating hours. Estimated weight — 31,000 lb

1 — Murray Iron Works Air Compressor — 1500 cu ft free air per min at 125 psi, Engine Type — Cross Compound Corliss for 160 lb steam pressure operating condensing, complete with surface condenser and auxiliaries. Unit is capable of operating on 5 lb back pressure if air discharge pressure is reduced to 100 psi. Estimated weight — 110,000 lb

These units were used for pumping water by air lift. This method has been superseded by deep well turbine pumps. Both units in operating condition and are available for immediate dismantling. May be inspected at the Cedar Street Pumping Station. Board of Water and Electric Light Commissioners, Lansing, Michigan

GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR WATER GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

GUARANTEED pH & PHOSPHATE COLOR STANDARDS

with Taylor Comparators simplify boiler water control

Every Taylor Comparator comes to you with a full set of liquid color standards that carry an *unlimited guarantee against fading.* Moreover, each complete set of color standards is mounted in a sturdy plastic slide, thus eliminating the need for handling fragile single standards.

And they are easy to use, give accurate results in just one or two minutes. NO TECHNICAL TRAINING NECESSARY. Complete instructions come with each set.

Taylor sets are available for pH, high and low phosphate, polyphosphate, nitrate and many other determinations. All sets are complete with slides, base, reagents and accessories. Many slides can be used on one base.

Taylor Hardness Set eliminates soap tests!

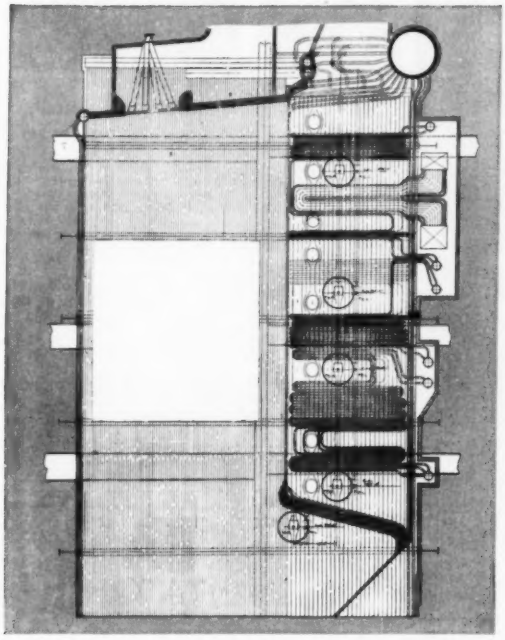
Operates on the familiar Versenate method, a simple titration. Saves time, trouble, gives accurate results.

See Your Dealer

FREE HANDBOOK
gives theory and value of pH control in 34 basic industries, illustrates and describes full Taylor line. Write for your copy today.

W. A. TAYLOR AND CO.
410 ROGERS FORGE RD • BALTIMORE 4, MD

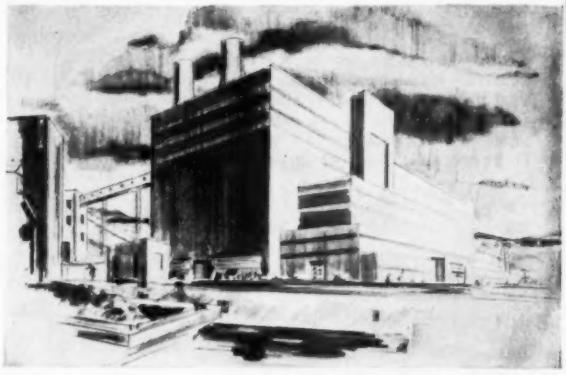
It's VULCAN *at* ELRAMA POWER STATION
4th VULCAN SYSTEM *for*
DUQUESNE LIGHT COMPANY



Each of the two B & W radiant-type boilers, fired with pulverized coal, will be equipped with ten air-driven Vulcan Long Retractables blowing with steam under push button control.

For the fourth time in its $112,000,000 post-war expansion and construction program, Duquesne Light Company has ordered Vulcan Automatic Soot Blowers. This latest order is for the new Elrama Power Station near Clairton, Pennsylvania which will add 190,000 kilowatts to the system generating capacity. Each of the two Babcock & Wilcox radiant-type boilers will have a capacity of 900,000 pounds of steam per hour at 1350 psi and 950 degrees F. Each will have ten air-driven Vulcan Long Retractables, blowing with steam under push button control. The swing to Vulcans continues, as alert engineers learn that Vulcan cleans better and costs less to maintain.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA



ELRAMA POWER STATION
DUQUESNE LIGHT COMPANY

VULCAN *Automatic Soot* **BLOWERS**

WILSONIZE to economize

This CURVE-TUBE MOTOR

gives up to 40% more power while "taking the curves"

Here is a curve-tube motor with real power. The Wilson ECT Series Air Motor "takes the curves" easily . . . does an efficient cleaning job. Size-for-size, the ECT has developed up to 40% more power than ordinary motors. These design features tell why: automatic valving of operating air, six-blade rotor, special lightweight blades.

You get these important advantages: (1) higher torque at any speed because of six-bladed construction; (2) less air consumption with a minimum of back pressure; (3) positive starting—hard to stall; (4) less downtime because tube cleaning jobs are faster, more thorough; (5) saves on labor and keeps production up; (6) no extra cost.

WILSON *Tube Expanders insure firm seating*

They have a smooth, parallel rolling action that insures firm seating of the tube . . . gives you tighter, perfectly rolled joints. There is a Wilson Tube Expander for every need, from 3/16" ID to 12" ID. Bulletin 380 on request. TW 604

THOMAS C. WILSON, INC.
21-11 44th AVENUE, LONG ISLAND CITY 1, N. Y.
Representatives in all principal cities
CABLE ADDRESS: "TUBECLEAN", NEW YORK

WILSON
TUBE CLEANERS • TUBE EXPANDERS

POSITIVE! EFFICIENT! SAFER!

VALVE CONTROL AT LOWEST COST!

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

INSTALLED, AND OPERATING, IN ONLY A FEW MINUTES

● Here's easy, convenient, instant control of overhead, out-of-reach valves—right from the floor! No expensive apparatus! No switches! Nothing to break down when most needed! BABBITT Adjustable Sprocket Rim with Chain Guide, with only four simple parts, gives you positive efficient valve control at lowest cost!

● Prevents accidents, prevents waste, provides efficient control, and saves money. A range of 10 ADJUSTABLE sizes fits all valve wheels with rising or non-rising stems, from 2 to 30 inches in diameter.

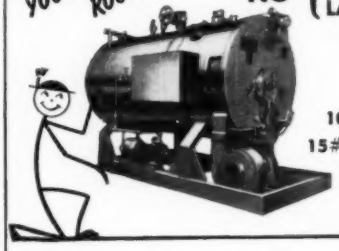
Distributors in Principal Cities, or send for Catalog Folder PE-2 and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square
NEW BEDFORD, MASSACHUSETTS

AMESTEAM GENERATOR

JUST SET IT ON YOUR BOILER ROOM FLOOR!

NEEDS NO { FOUNDATIONS, BRICKWORK, LARGE STACK

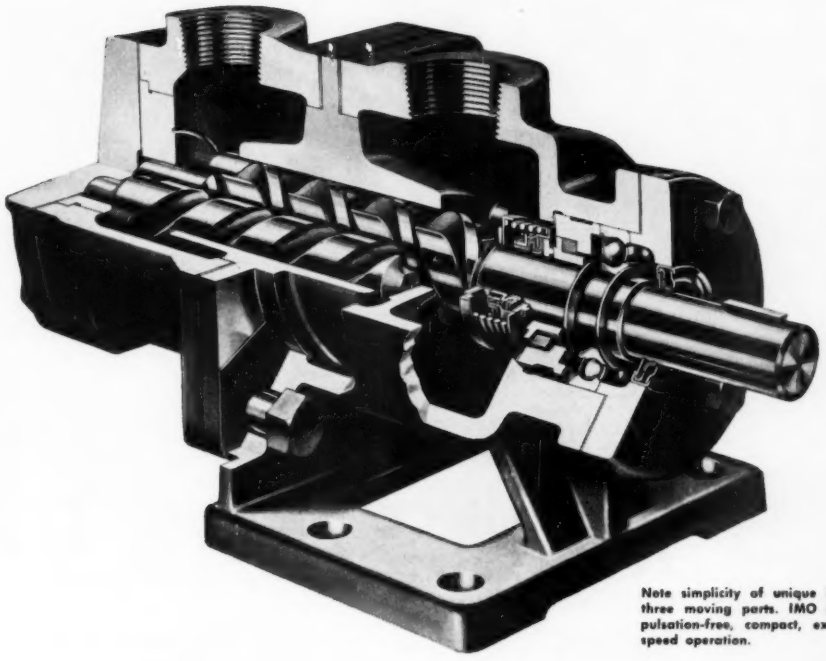


10 to 500 h.p.
15# to 200# w.p.
OIL or GAS

You Supply Fuel Tank, Gas Vent and Service Connections . . . We Supply the Rest

AMES IRON WORKS
BOX M-3, OSWEGO, N.Y.
Builders of Better Boilers Since 1848

NOW...a new **LOW-COST** IMO for HIGHER pressures



Note simplicity of unique IMO design—only three moving parts. IMO is reliable, quiet, pulsation-free, compact, excellent for high-speed operation.

You've either heard about or used the proven De Laval—IMO A313A pump. Now De Laval brings you the A313B IMO for a wide variety of oil handling applications for higher pressures. This quality-designed, quantity-produced pump saves you up to 40% in initial cost over other IMO models for pressures up to 275 psi.

This new rotary positive displacement pump gives you all the advantages of the famous IMO pumping principle. Use it for capacities to 80 gpm, pressures to 275 psi and intermittent pressures to 325 psi... It handles light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, lubrication, governing systems and similar services.

DE LAVAL OFFERS IMMEDIATE DELIVERY OF NEW **IMO PUMP!** WRITE TODAY!

DE LAVAL *IMO Pumps*

STANDARD PRODUCTS DIVISION

DE LAVAL STEAM TURBINE CO., TRENTON 2, NEW JERSEY

DL-124

SIMPLICITY!

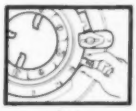
Low Upkeep Cost
Trouble-Free

BEAVER NO. 26-R
1 TO 2-INCH PIPE THREADER

5 OUTSTANDING ADVANTAGES

Right or left hand models

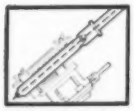
Radio Dial Setting Change in 2 Seconds



Dies Easily Removed from Outside

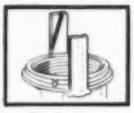
• The new Beaver 26-R is a greatly improved and simplified successor to the "old Beaver 26," popular for 40 years. Drive ring is on top—in line with dies for easy cutting. Oversize, undersize or standard threads can be cut of uniform length. Has "radio dial" setting. Change size in 2 seconds without tools. Standard taper or electric conduit threads. One set dies. No bushings.

BEAVER PIPE TOOLS, INC.
274-300 DANA AVENUE • WARREN, OHIO, U.S.A.
"Over 50 Years of Friendly Service"

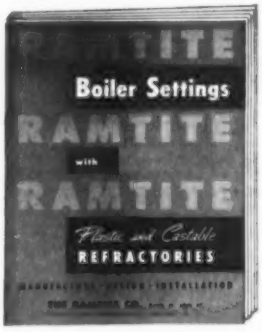


Straight Line Pull Easier Cutting

Universal Chuck • Accurate Centering • No Bushings



Cuts Taper or Straight Threads



New 24-PAGE ILLUSTRATED BOILER SETTING CATALOG

Anyone concerned with boiler operation and maintenance will find helpful reference material in this new catalog and data book. It contains numerous cross-sectional drawings, charts, technical illustrations, and other data—in the field of plastic and castable refractories and their applications in modern boiler settings. The book also presents information about refractory manufacture, design and installation.

...SERVES EVERY INDUSTRY USING HEAT

RAMTITE

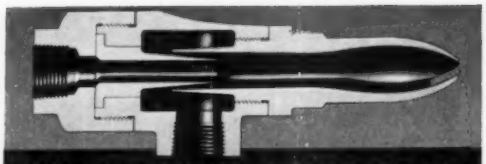
THE RAMTITE CO.
Division of The S. Obermayer Co.
2561 West 18th Street, Chicago 8, Illinois
Please send a copy of your new 24-page catalog.

Company Name_____

Attention Mr._____ Title_____

Address_____

City_____ Zone____ State_____



CONTINUOUS OPERATION WITHOUT CLOGGING OR CLEANING . . .

LOW STEAM CONSUMPTION

NATIONAL AIROIL

TYPE "SA" OIL BURNER

The popular NATIONAL AIROIL Steam Atomizing Oil Burner *thoroughly atomizes* and *completely burns* the lowest and cheapest grades of fuel oil or tar . . . requires minimum supervision and maintenance. Only slight oil pressure and temperature is needed . . . and internal atomizing venturi feature assures low steam consumption.

NATIONAL AIROIL Type "SA" Oil Burner is adaptable to all types of industrial heating, power or process furnaces . . . is suitable for firing above stoker grates on conversion to oil.

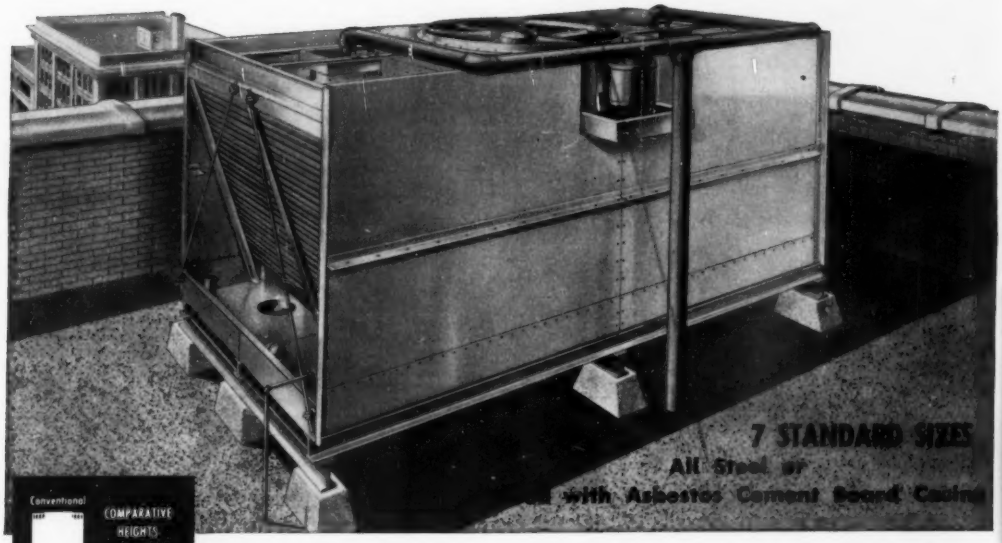
Write for Bulletin 21.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
LOW AIR PRESSURE OIL BURNERS
GAS BURNERS
COMBINATION GAS and OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
FUEL OIL HEATERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.
Main Offices & Factory: 1260 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

NEW DOUBLE-FLOW AQUATOWER

Marley Introduces Lowest Silhouette, Lowest Pumping Head Cooling Towers For Intermediate Capacities



New Simplicity • New Accessibility • New Efficiency

By combining the outstanding features of the large patented Double-Flow and the smaller Aquatower (both accepted leaders in their fields), Marley has produced the cooling tower that will set the standard in another size range . . . THE DOUBLE-FLOW AQUATOWER. Architects, engineers and contractors will be equally enthusiastic about this tower because it is highly efficient, lowest in height and harmonious with building design, and remarkably easy to erect.

The Double-Flow design means low tower height and low pumping head; efficient air utilization—one fan drawing air from two completely open sides—with consequent minimum fan horsepower requirement. Open distribution, "at-a-glance" inspection are features, as are minimum load concentration and economical grillage and support.

From the Aquatower comes simplicity . . . of construction, of piping, of operation. The nailless Redwood filling that is very easily installed or removed is another adaptation. All basin fixtures are readily at hand. Double-Flow Aquatower mechanical equipment is all designed, manufactured and guaranteed by Marley specifically for cooling tower usage . . . and it is all completely accessible.

You'll want complete details of this tower that will fit many installations in many industries, typical of which are those requiring 50 tons or more of refrigeration. Fill out the coupon below and you will receive it immediately.

Producers of
DOUBLE-FLOW TOWERS
AQUATOWERS
VAIRFLO TOWERS
CONVENTIONAL TOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.
222 West Gregory, Kansas City 5, Mo.

Send me your 8-page brochure on the new Marley DOUBLE-FLOW AQUATOWER.

Name_____

Firm_____

Address_____

City_____ State_____

Johnson-March system turned off at hammermill crusher in a large eastern plant. Note volume of dust. Compare this unretouched photo with the picture below.

This unretouched photo shows a Johnson-March system operating at the same crusher. Note absence of dust while coal is being crushed at rate of 250 tons per hour. These systems have proved themselves in many plants. We'll be glad to furnish names and addresses.

STOP COAL DUST

at 1/10 the usual cost!

If you have a dust problem—no matter how large or small—no matter where the dust occurs . . . car dumpers, hoppers, crushers, belt galleries, or coal pile—it can be controlled or eliminated with a Johnson-March system. Installation is fast, simple and inexpensive. There is no interference with normal plant operations.

No ducts, no fans and no cumbersome equipment are required. Johnson-March compounds added to water and a carefully engineered spray system do the work. The system is most effective, and its operation is so simple. It costs far less than other types of dust handling systems—on the average, only 1/10 as much. And maintenance costs next to nothing!

Even though you may have a mechanical dust collecting system, it will pay you to investigate a Johnson-March system.

Without cost or obligation, why not have one of our engineers discuss your dust problems with you? Just drop us a line.

Johnson March

Specialists in Dust Control

Dept. PE-1 • 1724 CHESTNUT STREET • Phila. 3, Pa.

ADVERTISERS in this issue

Air Preheater Corp., Inc. . . . 105
Agency — G. M. Basford Company
Allis-Chalmers Mfg. Co. . . . 15, 31
Agency — Compton Advertising, Inc.
American Chimney Corp. . . . 126
Ames Iron Works . . . 128
Agency — Melvin F. Hall, Inc.
Anderson, V. D. . . . 101
Agency — Will Inc.
Armstrong Machine Works . . . 4
Agency — Russell T. Gray, Inc.
Atlas Valve Co. . . . 124
Agency — W. F. Schaphorst
Babbitt Steam Specialty Co. . . . 128
Agency — Paul L. Kuch Advertising
Babcock & Wilcox Co., The . . . 26–27
Agency — O. S. Tyson and Company, Inc.
Bailey Meter Company . . . 32
Agency — Fuller & Smith & Ross, Inc.
Baltimore & Ohio R. R. . . . 45
Agency — Richard A. Foley, Inc.
Beaver Pipe Tools, Inc. . . . 130
Agency — Meek and Thomas, Inc.
Belmont Packing & Rubber Co. . . . 124
Agency — McNevin-Wilson-Dalldorf, Inc.
Betz, W. H. & L. D. . . . 87
Agency — The Harris D. McKinney Organization
Biddle Co., James G. . . . 92
Agency — The Roland G. E. Ullman Organization, Inc.
Bituminous Coal Institute . . . 53
Agency — Benton & Bowles, Inc.
Bridgeport Brass Co. . . . 134
Agency — Hazard Advertising Company
Chapman Valve Mfg. Co., The . . . Inside Back Cover
Agency — Sutherland-Abbott
A. W. Chesterton Co. . . . 114, 115
Agency — W. Robert Robotham, Inc.
Cities Service Oil Co. . . . 91
Agency — Ellington & Company, Inc.
Cochrane Corporation . . . 52
Agency — Willard G. Myers Advertising Agency
Combustion Engineering-Superheater, Inc. . . . 88–89
Agency — G. M. Basford Company
Condenser Service & Engineering Co., Inc. . . . 14
Coppus Engineering Corporation . . . 16–17
Agency — James Thomas Chirurg Co.
Crane Co. . . . 43
Agency — The Buchen Company
Dart Union Co. . . . 112
Agency — Sutherland-Abbott
Davis Engineering Corporation . . . 120
Agency — Thomas & Delehanty, Inc.
Dearborn Chemical Company . . . 49
Agency — The Buchen Company
De Laval Separator Co., The . . . 33
Agency — Donahue & Coe, Inc.
De Laval Steam Turbine Co. . . . 127
Agency — Michel-Cather, Inc.
Detroit Stoker Company . . . 39
Agency — Wilte & Burden
Drew & Co., Inc., E. F. . . . 117
Agency — The Aitkin-Kynett Co.
Edward Valves, Inc. . . . 94–95
Agency — Marstellar, Gebhardt and Reed Inc.
Elliott Co. . . . 2–3, 96
Agency — Peterson & Kempner, Inc.
Engineer Co. . . . 30
Agency — Michel-Cather, Inc.
Everlasting Valve Co. . . . 100
Agency — Michel-Cather, Inc.
Garlock Packing Co., The . . . 28
Agency — Hutchins Advertising Company, Inc.
General Coal Co. . . . 118
Agency — The Aitkin-Kynett Co.
Graver Water Conditioning Co. . . . 21
Agency — Michel-Cather, Inc.
Green Fuel Economizer Co. . . . 104
Agency — Sanger-Funnell, Incorporated
Grinnell Company, Inc. . . . 97
Agency — Horton-Noyes Co.
Griscom-Russell Co., The . . . 90
Agency — Michel-Cather, Inc.
Gulf Oil Corp. . . . 93
Agency — Young & Rubicam, Inc.
Hagan Corporation . . . 102
Agency — Ketchum, MacLeod & Grove, Inc.

Hall Laboratories, Inc. . . . 29
Agency — Ketchum, MacLeod & Grove, Inc.
Johnson-March Corp. . . . 132
Agency — Beaumont, Heller & Sperling, Inc.
Johns-Manville . . . 126
Agency — J. Walter Thompson Company
Ladish Co. . . . 19
Agency — The Cramer-Krasselt Co.
Manning, Marwell & Moore . . . 25
Agency — Fuller & Smith & Ross, Inc.
Marley Co., The . . . 131
Agency — Valentine-Radford
National Airoil Burner Company, Inc. . . . 130
Agency — R. E. Lovekin Corp.
National Aluminate Corporation . . . 35
Agency — Armstrong Advertising Agency
National Valve & Mfg. Co. . . . 34
Niagara Blower Company . . . 103
Agency — The Moss-Chase Company
Nicholson & Co., W. H. . . . 122
Agency — Wilbur A. Myers
Norton Company . . . 111
Agency — James Thomas Chirurg Company
Ohio Injector Co. . . . 6
Agency — Fuller & Smith & Ross, Inc.
Owens-Illinois Glass Co., Kaylo Div. . . . 36
Agency — Canaday, Ewell & Thurber, Inc.
Pacific Pumps Inc. . . . 109
Agency — The McCarty Co.
Permutit Co., The . . . Back Cover
Agency — Cunningham & Walsh, Inc.
Powell Co., The Wm. . . . 47
Agency — Associated Advertising Agency, Inc.
J. F. Pritchard (Equip. Div.) . . . 120
Agency — Carter Advertising Agency
% Proportioneers, Inc. % . . . 9
Agency — Hammond-Goff Co.
Ramtite Co. . . . 130
Agency — Marstellar, Gebhardt and Reed, Inc.
Raybestos — Manhattan, Inc. . . . 20
Agency — Gray & Rogers
Reliance Gauge Column Co. . . . 110
Agency — Carr Liggett Advertising Inc.
Republic Rubber Division . . . 40
Agency — Meek and Thomas, Inc.
Richardson Scale Co. . . . 98
Agency — O. S. Tyson and Company, Inc.
Riley Stoker Corporation . . . 22–23
Agency — The Davis Press, Inc.
Roto Div. of Elliott Co. . . . 108
Agency — Jos. S. Vogel & Co.
Milton Roy Co. . . . 107
Agency — Harris D. McKinney
R-S Products Corporation . . . 116
Agency — Carl M. Craig Agency
Scovill Mfg. Co. . . . 123
Agency — James Thomas Chirurg Company
Standard Oil Co. (Indiana) . . . 41
Agency — McCann-Erickson, Inc.
Sun Oil Company . . . 12–13
Agency — Gray & Rogers
Swartwout Company, The . . . 51
Agency — Palm & Patterson
Taylor & Co., W. A. . . . 126
Agency — Emery Advertising Corporation
Terry Steam Turbine Co., The . . . 119
Agency — Gassaway, Mark & Co.
United States Rubber Company . . . 24
Agency — Fletcher D. Richards, Inc.
Vaco Products Co. . . . 133
Agency — Kencliffe, Breslich & Co.
Vogt Machine Co., Henry . . . 121
Agency — Farson & Huff
Vulcan Soot Blower Division, Continental Foundry & Machine Company . . . 127
Agency — Davies and McKinney
Wallace & Tiernan Products, Inc. . . . 106
Agency — Branstater-Hammond
Watson-Stillman Co. . . . 18
Agency — McNevin-Wilson-Dalldorf, Inc.
Wheeler Mfg. Co., C. H. . . . 125
Agency — The Roland G. E. Ullman Organization, Inc.
Wickes Boiler Co., The . . . 113
Agency — Price, Hedrick & Tanner, Inc.
Wilson, Inc., Thomas C. . . . 128
Agency — Michel-Cather, Inc.
Wright Chemical Co. . . . 122
Agency — Schnell & Associates
Worthington Pump & Machinery Corp. . . . 99
Agency — James Thomas Chirurg Company
Yarnall-Waring Company . . . 10–11, 54
Agency — Michener & Holland

More and More Industrial Users Specify . . .

Only Vaco Offers Such Uniformly High Quality... So Many Styles and Sizes ... At Such Low Overall Cost!

• Yes, industrial users everywhere . . . men who know quality, value and price in tools . . . rely more and more on Vaco for every screw driver need. Made with electrically heat treated chrome vanadium steel blades and exclusive Vaco Amberyl fire-safe handles, Vaco products give more for the money . . . are low cost in the long run. Buying is easy, too, because there are more than 250 Vaco stock styles and sizes . . . all your regular, Phillips, clutch head, Reed and Prince, Klipxon, offset and specialty drivers from *one* source!

Another VACO "Special"—
Beryllium Copper Non-Sparking Drivers

The new Vaco Beryllium-copper screw drivers have found immediate acceptance where there is an explosion hazard. Nearly as strong as finest steel, yet completely spark proof, these fine drivers are durable as well as safe. Prices are conservative . . . full information on request.

FREE 32-Page Handbook-Catalog

Users of screw drivers have found the new 1952 Vaco catalog to be a veritable mine of information. Every major type of driver is illustrated. Complete tables give all useful application data including bit size, handle diameter and length, blade dimensions, screws to be driven, etc. Send for your free copy, *today!*

VACO PRODUCTS CO.
317 E. Ontario Street, Chicago 11, Illinois

In Canada: Vaco-Lynn Products Co., Ltd.
204 Laurier Ave. W., Montreal 8, Quebec

More Than 250 Screw Driver Styles and Sizes!

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

ALUMINUM BRASS GIVES GOOD SERVICE
Under Severe Operating Conditions

Continuous operation associated with higher operating efficiency is putting a heavier burden on condenser and heat exchanger tubes. Alloys which gave a good account of themselves in former years when equipment was operated intermittently well within design velocities, are failing under the grueling effect of constant operation.

It is well known that petroleum refinery units are kept going 'round the clock month after month until breakdown of individual pieces of equipment makes it more practical to shutdown the unit for major overhauling. Likewise in the power generating field, the accelerated demand for power in the last decade has in many cases not only utilized standby equipment going at full schedules but has often called for power output beyond design capacity.

This explains why alloys such as Admiralty, which gave such excellent performance in former years in certain condenser installations, often fail prematurely when used for retubing under present severe operating conditions.

On the other hand, such alloys as aluminum brass (78% copper, 2% aluminum and 0.03% arsenic, balance zinc) have been growing in importance and are replacing Admiralty in many installations. Aluminum brass is inherently more resistant to corrosion than Admiralty from both slow and rapidly moving sea water as well as polluted waters in harbors and rivers that are contaminated by sewage and industrial wastes. Aluminum brass, when replacing Admiralty, generally gives a better account of itself particularly where inlet-end corrosion or impingement corrosion has been a serious problem.

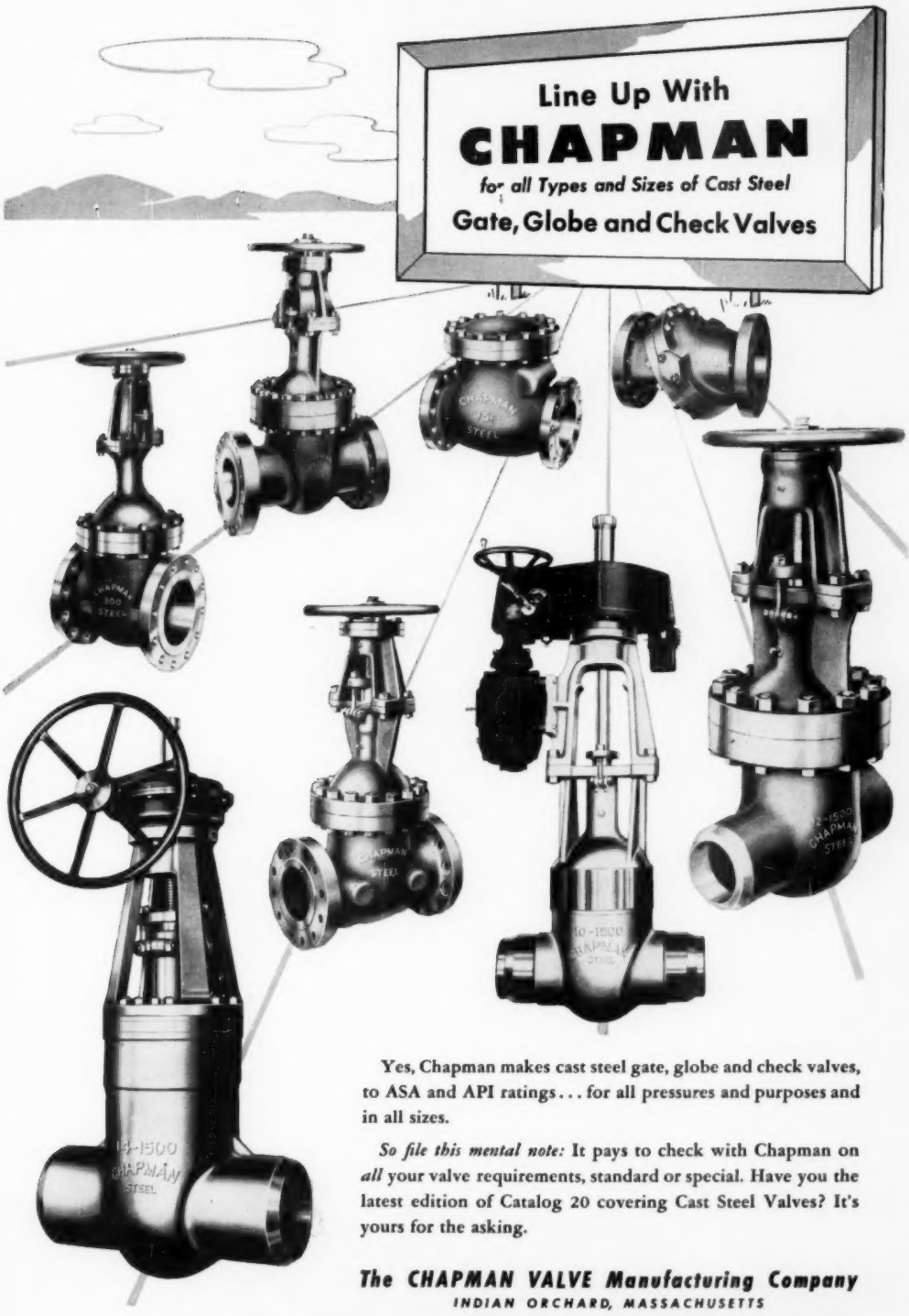
It has also been found that higher velocities of circulating water, either fresh or salt, are prone to attack Admiralty more severely than aluminum brass. It must be borne in mind that it is necessary to use arsenic as an inhibitor of dezincification in aluminum brass as well as in Admiralty to assure longer service life.

In common with Admiralty, aluminum brass has good corrosion resistance to sulphur compounds found in various petroleum liquids and gases.

The table giving comparative physical and mechanical properties of arsenical aluminum brass versus arsenical Admiralty should be helpful to design engineers. (8022)

COMPARATIVE PHYSICAL AND MECHANICAL PROPERTIES OF ARSENICAL ALUMINUM BRASS AND ARSENICAL ADMIRALTY

ANALYSIS	Aluminum Brass 54	Arsenical Admiralty 30
Copper	77.0	71.0
Tin		1.05
Aluminum	2.1	
Arsenic	0.03	0.03
Zinc	balance	balance
MECHANICAL PROPERTIES		
Tensile Strength—Soft	50,000	45,000
Yield Strength—Soft	18,000	15,000
Elongation % in 2" Soft	55	65
Contraction in Area % Soft	72	71
Rockwell Hardness—Soft	F77	F75
Elastic Limit—Soft	16,000	18,000
Modulus of Elasticity in Tension x 10^6	16	16
PHYSICAL CONSTANTS		
Density @ 68°F lbs./cu. in.	.301	.308
Specific Gravity	8.33	8.53
Melting Pt. °F Liquidus	1780	1720
Solidus	1710	1650
THERMAL CONSTANTS		
Coefficients of Thermal Exp. per °F from 68°F to 572°F x 10^{-6}	10.3	11.2
per °C from 20°C to 300°C x 10^{-6}	18.5	20.2
Thermal Conductivity at 68°F BTU/sq. ft./ft./hr./°F	58	64
Calories/cm^2/cm/sec/°C	0.24	0.26
Thermal Capacity (spec. heat) @ 68°F BTU/lb./°F	.09	.09
@ 20°C cal./gm./°C	.09	.09
ELECTRICAL CONSTANTS		
Resistivity ohms/mil foot @ 68°F (annealed)	45	42
Conductivity % IACS @ 68°F (annealed)	23	25
(annealed) megmbo-cm^3 @ 20°C	0.133	0.145
Resistivity, micro-ohm centimeters @ 20°C (annealed)	7.5	6.9
Color	Yellow	Yellow
FABRICATION PROPERTIES		
Cold working	Excellent	Excellent
Hot working	Fair	Fair
Hot working Temp. °F	1400-1600	1200-1450
Hot Working Temp. °C	750-875	650-800
Machinability rating	20	30
Soft soldering	Good	Excellent
Silver brazing	Good	Good
Oxyacetylene welding	Good	Good
Carbon arc welding	Good	Fair
Resistance welding	Good	Fair
Polishing	Good	Good
Annealing Temp. °F	800-1100	800-1100
SPECIFICATIONS		
A.S.T.M	B-111-50	B-111-50
U. S. Navy		44T7g
Federal		WW-T-756a

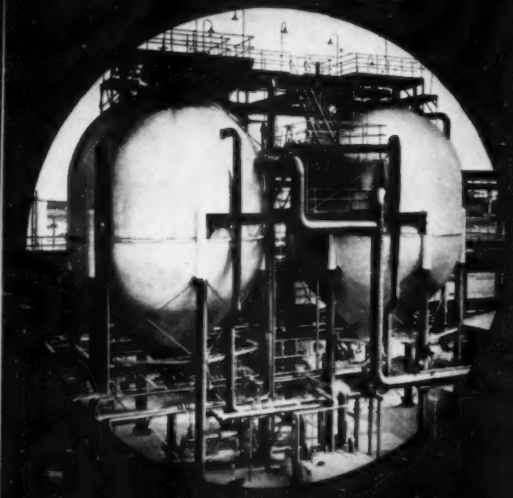


Yes, Chapman makes cast steel gate, globe and check valves, to ASA and API ratings . . . for all pressures and purposes and in all sizes.

So file this mental note: **It pays to check with Chapman on *all* your valve requirements, standard or special. Have you the latest edition of Catalog 20 covering Cast Steel Valves? It's yours for the asking.**

The CHAPMAN VALVE Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

BIG "CATS" NEED GOOD WATER TOO . . .



Permutit two-stage hot lime soda and phosphate water softener recently installed at The Texas Company's Eagle Point Refinery.

WATER CONDITIONING HEADQUARTERS FOR 40 YEARS

—*and Permutit Equipment brings it, at lower cost, to The Texas Company's new Eagle Point "cat" crackers . . .*

The Texas Company, at their Eagle Point Works in Westville, N. J., processes 60,000 barrels of crude per day, in which processing modern fluid catalytic cracking is used. Over-all refinery steam and electric power balance dictated refinery boiler plant operation at 900 psi. Treated water is used on waste heat boilers on the cat cracker. They operate a Permutit two-stage hot lime soda and phosphate water softener to protect their boilers against scale and corrosion. Permutit equipment and its location are illustrated.

The Texas Company is but one of many concerns which realizes the value of proper water softening. To solve water conditioning problems, manufacturers in hundreds of industries have turned to Permutit. With 40 years of experience in water treatment, Permutit possesses the know-how to solve water conditioning problems economically at lower initial cost, with greater continuing savings.

For aid in the solution of your own water problems, write to The Permutit Company, Dept. PE3, 330 West 42nd Street, New York 36, N. Y. or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT